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PHYSOSTEGIA ABORIGINORUM, all figs. from TYPE: FIG. 1, plant, × ½; FIG. 2, flower, × 2; FIG. 3, fruiting calices, × 5

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THE NEW ENGLAND BOTANICAL CLUB

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MICROCHEMICAL STUDIES ON THE GENUS CLADONIA, SUBGENUS CLADINA[1]

Alexander W. Evans

The species of *Cladonia* are distinguished from one another not only by morphological differences but also in many cases by differences in the lichen-acids and related substances which they produce. In the subgenus *Cladina*, for example, it has long been known that *C. rangiferina* (L.) Web. produces atronorine and fumarprotocetraric acid but that *C. sylvatica* (L.) Hoffm., although agreeing with *C. rangiferina* in forming fumarprotocetraric acid, differs in producing usnic acid instead of atronorine. Each of the other species of *Cladina* produces one or two of the three substances mentioned but no species, according to our present information, produces all three.

Prior to the introduction of Asahina's microchemical methods (see Evans, **13**) several additional lichen-substances had been found in the *Cladinae* by Zopf and by Hesse (see Sandstede, **14**) and some of these had been given names, such as cornicularine, erinacine, laxiuscine, and sylvatic acid. Unfortunately these substances were not fully characterized, and later writers have failed to identify them with any degree of certainty.

One of the first to apply Asahina's methods to a species of *Cladina* was Duvigneaud (**5**), who examined Belgian specimens of *C. impexa* Harm. He extracted his material with choloroform and treated the residue left after evaporation with Asahina's

[1] Contribution from the Osborn Botanical Laboratory. The writer wishes to thank Professor Alexander Petrunkevitch for the photographs used in Figs. 1, 2 and 6, and Dr. Robert T. Brumfield for the photograph used in Fig. 4.

G. E. solution.[1] In his preparations he found not only the characteristic crystals of usnic acid but also those of another substance, which he described as arborescences formed by aggregation of colorless curved needles. He expressed the opinion that this substance might be the same as erinacine, which was obtained from a form of *C. impexa*, but left the matter in doubt. Duvigneaud obtained identical crystals, unaccompanied by usnic acid, from another Belgian *Cladonia* which was morphologically like *C. impexa*. He considered the absence of usnic acid a sufficient reason for separating this plant from *C. impexa* and described it as a new species under the name *Cladonia subimpexa*.

The results of Duvigneaud's studies were published in 1939, and later in the same year des Abbayes' monograph of the subgenus *Cladina* (**4**) made its appearance. In this important work the author utilized Asahina's methods for the demonstration of atronorine and usnic acid in the *Cladoniae* and emphasized the value of paraphenylenediamine, usually designated by the letter P, for the detection of fumarprotocetraric acid. In discussing *C. subimpexa*, des Abbayes showed that the production of usnic acid is increased in strong sunlight but that species normally forming this substance may contain only a small amount or even none at all if growing in the shade (**4**, p. 17). He therefore interpreted *C. subimpexa* as a shade-form of *C. impexa* and reduced it to synonymy under f. *exalbescens* (Vainio) des Abbayes (**4**, p. 79).

In 1940 Asahina (**3**) applied his methods to the following representatives of the subgenus: *C. impexa*, *C. pseudoevansi* Asahina (a species proposed as new), *C. Evansi* des Abbayes (see **4**, p. 71), and *C. alpestris* (L.) Rabenh. In the first three he was able to demonstrate the presence of perlatolic acid, a substance originally extracted from *Parmelia cetrarioides* Del. var. *typica* DR. (see Asahina **2**, p. 40). This substance in the G. E. solution forms characteristic crystals, which are perhaps the same as those found by Duvigneaud in *C. impexa*. Asahina, however, does not suggest that perlatolic acid is identical with any of the substances previously reported in the *Cladoniae*. According to his results the acid is associated with usnic acid in *C. impexa* and *C. pseudoevansi* and with atronorine in *C. Evansi*.

[1] Composed of one part of glycerine and three parts of glacial acetic acid.

Asahina's study of *C. alpestris*, another species producing usnic acid, was based on two series of specimens which differ in their reaction to P. In one series this reagent gives rise to a distinct yellow color; in the other it produces no color change whatever. Plants showing the first reaction had already been observed by des Abbayes, who had separated them from the rest of the species as f. *aberrans* (**4**, p. 93). He suggested that the substance causing the yellow color might be psoromic acid, and Asahina by means of his microchemical methods was able to prove that this was the case. According to our present knowledge f. *aberrans* is the dominant form of *C. alpestris* in Japan. It occurs also as a rarity in North America but is unknown in Europe.

Asahina's material of *C. alpestris* showing the P− reaction consisted of 15 specimens from Europe, 3 from North America, and 3 from Japan. The specimens from Europe and North America were selected from Sandstede's *Cladoniae* exsiccatae. His preparations were obtained by extracting fragments of the podetia with acetone and by adding the G. E. solution to the dried residue. After the application of gentle heat two types of crystals, which he described as colorless, made their appearance. Since the chemical nature of the substances forming the crystals was unknown to him he designated them by the letters A and B, respectively. According to his brief descriptions crystals of type A, represented by his fig. 8, look like snow-crystals, whereas those of type B, represented by his fig. 9, are in the form of needles aggregated into radiate or tail-like clusters. He compared the latter with the crystals of psoromic and perlatolic acids but stated that they differed from those of psoromic acid in their P− reaction. Unfortunately he neglected to point out any distinctions between crystals of type B and those of perlatolic acid, and the examples shown in fig. 9 are hardly distinguishable from the crystals of perlatolic acid shown in his figs. 1, 5 and 6.

With the exception of *C. pseudoevansi*, which is known only from Japan, the writer has re-examined the species of *Cladina* studied by Asahina and has been able to confirm his statements regarding *C. impexa*, *C. Evansi*, and *C. alpestris* f. *aberrans*. In the case of P− specimens of *C. alpestris*, however, four different kinds of crystals, instead of two, made their appearance in the G. E. solution, in addition to the crystals of usnic acid. These

crystals were obtained from the numbers of Sandstede's *Cladonias* exsiccatae cited by Asahina, supplemented by other specimens from Europe and North America. In some cases the best precipitation occurred after the preparations had been left standing for several hours, although certain crystals could be demonstrated in the course of a few minutes. Of the four types of crystals found one is clearly the same as Asahina's type A, although it is not wholly without color. The second type, which occurs in over three-fourths of the specimens tested, is referred with considerable hesitation to Asahina's type B. This, too, shows a distinct coloration and differs in several respects from his description and figure. The third type, which is really colorless, is apparently distinct from any of the crystals heretofore found in the *Cladoniae* and may be designated by the letter C. The fourth type, also colorless, is identified with perlatolic acid, since it agrees essentially with the crystals of this substance obtained from *C. impexa* and *C. Evansi*. It is possible, however, that this fourth type may be the same as Asahina's type B.

The application of Asahina's methods to other species of the subgenus *Cladina* soon made it evident that crystals of types A, B, and C are not confined to *C. alpestris*. In *C. mitis* Sandst., for example, according to its present delimitation, all three types occur, type A is found also in *C. sylvatica* (L.) Hoffm. and *C. tenuis* (Floerke) Harm., and type B may be associated with perlatolic acid in *C. impexa*. Attention may be called also to the colorless crystals of another substance which appeared in certain preparations of *C. mitis*. These crystals, which may be tentatively designated by the letter D, resemble the crystals of diffractic acid, as figured by Asahina (**1**, f. 31), but are apparently not identical with them.

The lichen-substances now definitely known in the *Cladinae* are the following: atronorine, fumarprotocetraric acid, perlatolic acid, psoromic acid, usnic acid, and the substances forming crystals of the types A, B, C, and D. To these may be added rangiformic acid, which has been reported in *C. mitis* by Asahina (see Sandstede, **15**, p. 91), and further investigations will undoubtedly bring still other substances to light. Asahina's methods for the demonstration of the first five substances listed have already been summarized by the writer in another connec-

tion (**13**), but the following descriptions of crystals A, B, C, and D, together with the additional data on the crystals of perlatolic acid, may be of interest to the student. It is hoped that these descriptions, although incomplete, may enable the taxonomist to recognize the various substances under consideration.

Crystals of type A

The crystals, which are here referred to type A, have a yellowish brown color, varying considerably in shade. They apparently

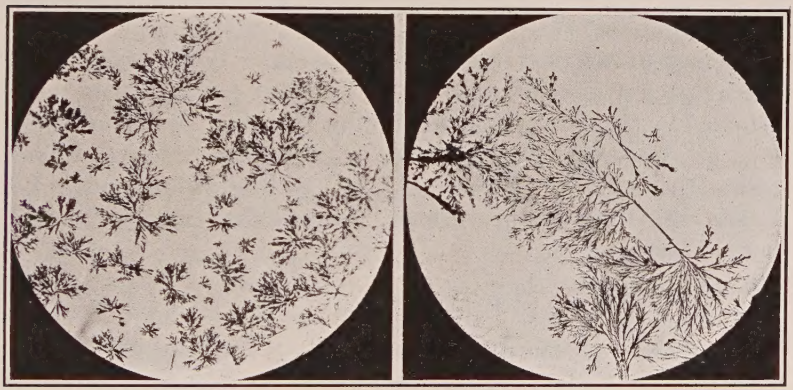

Fig. 1 Fig. 2

Fig. 1. Crystals of type A, × 42. Obtained from a specimen of *C. alpestris*, collected in 1933 by Torrey on North Mountain, Green County, New York, No. C-50.

Fig. 2. Crystals of type B, × 20. Obtained from a specimen of *C. alpestris*, collected in 1926 by Federov near Twer, Middle Russia, and distributed in Sandstede's *Cladoniae* exsic., No. 1714.

always occur in clusters. These, in their more typical form (Fig. 1) are radiate and show a superficial resemblance to snow-crystals but the rays, which may be simple or variously subdivided, are irregular and vary in number from five to ten. The width of the largest clusters observed was about 100μ, but it is rare for the width to exceed 60 μ. From the larger clusters, which are similar to those figured by Asahina (**3,** f. 8), there are all gradations in size down to the smallest clusters, which are barely 5 μ in diameter. In the smaller clusters, the rays are shorter, blunter, and less distinct than in the larger clusters and may not

be present at all. Under such circumstances the clusters form spherical or ellipsoidal masses. The crystals are so closely compacted in the clusters that it is difficult to determine their actual shape. They appear, however, to be in the form of needles or short rods, and in some cases an individual crystal projects from a cluster as a short pointed prism or flat plate 4–6 μ in width.

The formation of the crystals of type A is in many cases preceded by the appearance of yellowish areas in the preparations. These are mostly confined to the periphery, just within the edge of the cover-glass. The areas contain a profusion of minute oil-like droplets, suspended in a liquid, and it is possible that these may play a part in crystal-formation. As the crystals are precipitated in the yellowish areas the clusters may become surrounded by clear zones or halos. Many of the clusters, however, are not associated with the yellowish areas but are precipitated nearer the center of the preparation. Such clusters tend to be larger than those at the periphery and to show a more typical radiate arrangement.

Crystals of type B

The crystals of type B, according to the writer's interpretation, likewise show a yellowish or yellowish brown color but of a paler shade than in type A. Here, too, the crystals are united into clusters and these in their more characteristic development are in the form of complex branch-systems (Fig. 2), spreading out from a more or less definite point. In typical cases the main axes have a width of only about 1 μ and are scarcely if at all wider than the ultimate branchlets. Some of the largest and most elaborate branch-systems seen were over 2 mm. long, but these are exceptional and the smallest and simplest clusters are barely 30 μ long. The branching in general might be described as repeatedly pinnate, although examples of dichotomy are not infrequent. In the larger clusters branching takes place at intervals of 2–15 μ.

Although in normal examples the ultimate branchlets of a cluster taper to distinct points, there are cases in which a branchlet of this character is connected with a long yellow prismatic crystal having a width of 5–15 μ. Such a crystal broadens out gradually from a narrow base and then tapers more abruptly to

a point. In all probability it represents a crystal of usnic acid with which a crystal of the B type has coalesced. This hypothesis is supported by the fact that clusters of the B type may be attached by their bases to crystals of usnic acid, as shown by two of the large clusters in Fig. 2, both of which are attached to the same crystal at opposite ends. In combinations of usnic acid with clusters of the B type, the crystals of the latter are usually wider and show a more distinct yellow color than in normal clusters. The greater width, which may be as much as 5–6 μ, is found not only in the basal portion of a branch-system but also in branches of various ranks, including even the ultimate branches in clusters that are relatively simple. Apparently crystals of the B type are modified in some way by association with crystals of usnic acid, but it is difficult to determine how this is brought about. Since, however, the substance B is known only in species which produce usnic acid, the conditions for associations of this character seem to be always present.

The formation of crystals of type B may be preceded by the appearance of yellowish areas at the periphery of a preparation, similar to those described under type A. In these areas it is not unusual for a branch-system to extend inward from the edge of the cover-glass, and the clusters may be confined to this position, particularly if only a small amount of substance B is present. It may be noted also that crystals of usnic acid extending toward or into the yellowish areas are especially likely to become attached to clusters of type B. The individual crystals of a cluster are in the form of needles but it is difficult to tell where one crystal ends and another begins.

Crystals of type C

The crystals of type C are usually united in clusters but in rare instances isolated crystals can be demonstrated. These are in the form of thin navicular lamellae, pointed at each end and in some cases showing a slight sigmoid curvature (Fig. 3, a). Although the crystals may measure as much as 40–50 μ in length by 10–12 μ in width, most of them are considerably smaller. On account of its extreme transparency an isolated crystal is easily overlooked, particularly if it turns one of its faces toward the spectator. The clusters, fortunately, are more conspicuous and

stand out as grayish masses in a field dominated by the yellow crystals of usnic acid. In their simplest arrangement two to many crystals unite by their apices and form subcircular groups about 15 μ in diameter. The crystals under these circumstances show their edges and appear as slender rods or needles, in most cases variously curved or distorted. This indicates that they are not necessarily plane lamellae. If the curvatures are in one

Fig. 3

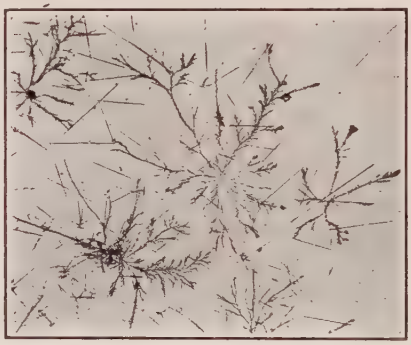

Fig. 4

Fig. 3. Crystals of type C, × 200. Obtained from a specimen of *C. submitis*, collected by the writer in 1932 at Killingworth, Connecticut, No. 3120.
Fig. 4. Crystals of type C and of usnic acid, × 28. Obtained from a specimen of *C. submitis* f. *prolifera*, collected by the writer in 1941 at Brooklyn, Connecticut, No. 5181a.

direction the cluster exhibits the characteristic appearance shown in Fig. 3, b. This regularity, however, is far from constant and the crystals, particularly in the more crowded clusters, may be curved in various directions (Fig. 3, c, d, e). Clusters in which many or all of the crystals appear straight are likewise not infrequent (Fig. 3, f).

In marked contrast to the clusters showing a subcircular outline are the much larger, irregularly radiate clusters (Fig. 4), which are occasionally produced. These bear a certain resemblance to the aggregates formed by the crystals of types A and B, but are at once distinguished by their total lack of color. The

radiate clusters vary greatly in size and the largest measured had a diameter of 0.25–0.3 mm. The rays are unequal in length and may be simple or variously subdivided. The axis of a ray, which has a width of about 6 μ, apparently consists of a row of overlapping and coalescent crystals, and upon this axis, throughout the greater part of its length, smaller and variously curved crystals are deposited. These may be scattered but tend to be crowded toward the extremities of the rays.

In some cases a third type of cluster appears at the periphery of a preparation, just within the edge of the cover-glass. The axis here consists of curved crystals seen on edge and attached end to end in such a way that an irregular branch-system is formed. Toward the interior of the preparation some of the branches may gradually broaden and become covered over with smaller crystals, thus acquiring the features of the rays of the radiate clusters.

Crystals of type D

In type D some of the crystals are in the form of exceedingly thin lamellae, others in the form of needles, and between these two extremes are numerous intergradations. In most cases the crystals are combined in clusters, and these may be large enough to extend completely across the field of the microscope. Even the largest clusters are easily overlooked on account of their extreme transparency, and the smaller clusters, which occur far more frequently, are still more inconspicuous. In some of the preparations small groups of lamellate crystals or even individual crystals can be demonstrated (Fig. 5, a). These are bounded by straight lines and are longer than broad with parallel sides. The ends may be bounded by two lines meeting at an obtuse angle or by continuous lines meeting the sides squarely or obliquely. Compound crystals are occasionally met with (Fig. 5, b). In the examples studied the lamellae varied in width from 2 μ to 50 μ and one of the largest seen had a length of 0.2 mm. In many instances the process of crystallization is incomplete and the bounding lines are zig-zag or otherwise irregular.

When the lamellae are seen on edge they appear as thin lines, which may be straight but which more frequently are curved in the form of a "C", showing that the crystals may be concave.

In clusters composed of lamellae alone the crystals may be superimposed upon one another (Fig. 5, c) or some of the crystals may be attached by their edges to the faces of other crystals. The latter condition is shown in Fig. 5, d, which represents two clusters composed of both lamellate and acicular crystals. It will be noted that the needles are attached to the lamellae at irregular intervals and that they form simple tufts or more elaborate branch-systems. In Fig. 5, e, a cluster composed entirely of somewhat shorter needles is shown. The cluster is in the form of a more or less pinnate branch-system, and even more complicated clusters of a similar type are not unusual. The needles of type D are in some cases so fine and delicate that they almost escape observation. A dense tuft of these exceedingly fine needles may show a pale brownish shade, although the majority of the clusters appear absolutely colorless.

In the subgenus *Cladina* crystals of the D type seem to be restricted to *C. mitis*. In the subgenus *Cenomyce*, however, the writer has demonstrated their presence in certain specimens of *C. rangiformis* Hoffm., a close relative of the common and widely distributed *C. furcata* (Huds.) Schrad. The crystals were found, for example, in Nos. 350, 490, 563, 684, 686, and 688 of Sandstede's *Cladoniae* exsiccatae, coming from various localities in northern and central Europe, although they were lacking in No. 173 from Norway and in No. 546 from Brandenburg. These data are sufficient to show that the substance D may be regarded as an accessory component of *C. rangiformis*. According to Zopf (**16,** p. 89) rangiformic acid also is a substance which may or may not be present in *C. rangiformis*, and Asahina (as already noted) has demonstrated the presence of this acid in *C. mitis*. It would of course be premature to suggest that there is any connection between the substance D and rangiformic acid, and yet it would not be surprising if further investigations proved them to be identical. Unfortunately, according to Asahina, rangiformic acid can not be demonstrated by microchemical methods.

Crystals of perlatolic acid

The crystals which perlatolic acid forms in the G. E. solution have been described by Asahina (**2,** p. 40). According to his account they are colorless and in the form of needles arranged in

bundles, which are grouped in irregular radiate clusters. These are clearly represented in his original figure (**2,** pl. 1, f. 3), which was based on preparations obtained from *Parmelia cetrarioides* var. *typica*. They are equally well shown in preparations obtained from *Cladonia impexa*, *C. pseudoevansi*, and *C. Evansi* (**3,** f. 1, 5 and 6). In the writer's experience the radiate clusters are usually precipitated at some distance from the edge of the cover-glass. The crystals of which they are composed are in the form

Fig. 5 Fig, 6

Fig. 5. Crystals of type D, × 200. Obtained from a specimen of *C. mitis*, collected in 1941 by Luttrell on Bald Knob, Giles County, Virginia, No. 2683.
Fig. 6. Crystals of perlatolic acid, × 20. Obtained from a specimen of *C. alpestris*, collected in 1941 by Sheldon near Siasconset, Nantucket, Massachusetts, No. S-145.

of long straight needles or narrow prisms, varying in width from less than 1 μ to 20 μ. Many of the crystals are simple throughout their entire length but others branch, usually by forking, and this process may be repeated. In most of the clusters one or more of the broader prisms, which taper to slender points, become covered, especially toward their tips, with loose or dense masses of short secondary crystals in the form of straight needles.

At the periphery of a preparation a somewhat different type of crystal-aggregate may make its appearance. This consists of one or more axial crystals which extend inward at right angles or obliquely from the edge of the cover-glass (Fig. 6). An axial

crystal, which is prismatic in form, broadens out gradually from a narrow base to a width or 6–8 μ and then tapers more abruptly to a sharp point. Upon this crystal toward its inner end a loose or dense mass of short acicular crystals is deposited, similar to those associated with the broader prisms of the radiate clusters. Unless these secondary crystals are sparingly produced the tip of an axis becomes completely concealed. Toward the base of the axial crystals slender branches may be given off, in some cases very abundantly. These in turn may branch repeatedly and form loose and more or less interwoven branch-systems.

Distribution of lichen-substances in C. alpestris

Although six different lichen-substances are now known in *C. alpestris*, usnic acid alone seems to be constant. In some specimens, indeed, this is the only lichen-substance that can be demonstrated, but such specimens are unusual. In most cases one or more of the other substances accompany the usnic acid, and if two or three are present these may occur in various combinations. In order to learn something definite about the distribution of lichen-substances in the species the writer has examined a series of specimens from Europe and a second series from North America.

The European specimens, all giving the P− reaction, include the following numbers from Sandstede's *Cladoniae* exsiccatae, under each of which the substances demonstrated are indicated by the letters A, B, and C, for the crystals designated by these letters, and by the abbreviation "Per.", for the crystals of perlatolic acid: 85 (B), 86 (B, Per.), 110 (A), 565 (A, B), 823 (A, B), 877 (B), 1020 (B), 1146 (A, B), 1232 (B), 1462 (B), 1463 (A, B), 1680 (B, C), 1701 (A, B), 1714 (B, Per.), 1715 (A, B, C, Per.), 1782 (A, B, Per.), 1797 (A, B, Per.), 1810 (A, B, C), and 1811 (A, B). These specimens came from various localities in central and northern Europe, and all but four (Nos. 85, 86, 1680, and 1715) are cited by Asahina (**3**, p. 190). No. 1715, which contains all four substances, was collected by Mrs. E. J. Dostojnova in northern Russia. Six additional European specimens were likewise examined, as follows: Utviken, Norway, *Sandstede* (B); Stegafyeld, Norway, *Sandstede* (B, C); Svalestein, Norway, *Havaas*, distributed in Lich. Norvegiae Occid. exsic., No. 76 (B);

Delarna, Sweden, *Holdsworth*, No. 6 (usnic acid only) and No. 7 (B); Tirol, *Arnold*, distributed as f. *inturgescens* Arnold in Lich. exsic., No. 1020 (A); and Bohemia, *Anders* (B, Per.).

These data show that substance A is present in 12 of the 27 specimens examined (about 46 per cent), B in 23 (about 85 per cent), C in 4 (about 15 per cent), and perlatolic acid in 6 (about 22 per cent). They show further that A and B accompany each other in 10 specimens (about 38 per cent) and that C and perlatolic acid are both accompanied by B. The figures given must not be accepted too literally. In some cases two or even three tests were required before characteristic crystals appeared, and it is therefore possible that some of the figures may be too low. At the same time they give a general idea of the distribution of substances A, B and C and of perlatolic acid in European material of *C. alpestris*.

The North American material of *C. alpestris* examined by the writer includes five specimens which give a yellow color with P and which therefore represent the following form:

Cladonia alpestris f. aberrans des Abbayes, Bull. Soc. Sci. Bretagne **16** (fasc. 2): 93. 1939. In the citation of the specimens the lichen-substances present are indicated and the abbreviation "Ps." designates psoromic acid. Alaska: White House Pass, *Heath*, 1903 (A, B, Per.). Quebec: Tadousac, *Torrey*, 1937 (B, Per., Ps.); Mt. Richardson, *Torrey*, 1937 (A, B, Per., Ps.). Pennsylvania: Lake Shehawken, *Dix*, 1939 (A, B, Per., Ps.).[1] Michigan: Carp Lake, Porcupine Mountains, Ontonagon County, *Nichols*, 1935 (A, Per., Ps.). Des Abbayes lists f. *aberrans* from Canada and from the island of St. Paul in the Bering Sea, as well as from Japan.

His record for Canada was based on Torrey's specimens from Quebec. It will be seen that psoromic acid has been demonstrated in four of the specimens listed. Repeated tests, however, gave negative results with the specimen from Alaska. This may have been due to the difficulty, which Asahina emphasizes, of detecting psoromic acid in the presence of an excess of usnic acid.

The North American material of *C. alpestris*, in which P produces no change in color, totals 119 specimens. These represent a distribution extending from Alaska and Labrador southward to Minnesota, Wisconsin, Michigan, and West Virginia. Seven of

[1] Reported as *C. alpestris* by Dix in Torreya **40**: 45. 1940.

the specimens were distributed in exsiccati, as follows:—Macoun, Lichenes exsic., No. 55, "common in Gàspé and on Anticosti, and in the Rocky and Selkirk Mountains; also north shore of Lake Superior, 1869," distributed as *C. rangiferina* var. *alpestris* (B). Cummings and Seymour, Decades N. Am. Lichens, No. 32, Wellesley, Massachusetts, 1891, distributed as *C. rangiferina* c. *alpestris* (A, B, Per.). Merrill, Lich. exsic., No. 6, Rockport, Maine, 1908 (A, B); No. 57, same locality, 1925 (usnic acid only). Sandstede, *Cladoniae* exsic., No. 667, Minnesota, *Fink*, 1894 (B); No. 1220, Rockland, Maine, *Merrill*, 1924 (A); No. 1567, Wareham, Massachusetts, *Robbins*, 1925 (B). The last three specimens are among those listed by Asahina (**3**, p. 190). Without enumerating the other specimens the distribution of substances A, B and C and of perlatolic acid may be summarized. Of the 118 specimens examined 56 (or about 47 per cent) were found to contain substance A, 79 (or about 76 per cent) substance B, 10 (or about 8 per cent) substance C, and 33 (or about 28 per cent) perlatolic acid. These numbers do not diverge very widely from the percentages 46, 85, 15, and 22, respectively, derived from European material.

The question now arises, what is the taxonomic significance of the various substances found in *C. alpestris?* In other words should plants producing the substance A, for example, be separated as a distinct variety or form from plants which do not produce this substance? This question might be answered in the affirmative: (1) if plants producing the substance A were also distinguished by morphological differences; (2) if they occupied a restricted geographical range; or (3) if the presence of A excluded B, C, or perlatolic acid, either singly or in combination. According to our present knowledge not one of these conditions is fulfilled. The writer suggests, therefore, that A, B, C and perlatolic acid, so far as *C. alpestris* is concerned, be regarded merely as accessory substances having no taxonomic significance.

Whether an exception should be made in the case of f. *aberrans* is also open to question. This form, to be sure, is characterized by a distinct color-reaction with P, but this depends simply upon the presence of psoromic acid. There are, unfortunately, no morphological features characterizing f. *aberrans*, and the psoromic acid may be accompanied by perlatolic acid, as well as

by the substances A and B. Since, however, f. *aberrans* is known only from North America and Japan, it perhaps deserves recognition on the basis of its restricted geographical distribution.

Distribution of lichen-substances in C. mitis

According to the results obtained by the writer usnic acid is the only constant constituent of *C. mitis*, the species agreeing in this respect with *C. alpestris*. The following account of the distribution of the other lichen-substances found in the species is based on 125 specimens from Europe, 524 from North America, and 4 from Chile and New Zealand. The species is known also from Asia and Africa (see des Abbayes **4**, p. 127), but the writer has seen no specimens from either of these continents.

The European material examined includes a long series from Sandstede's *Cladoniae* exsiccatae, 6 numbers from des Abbayes' Lichenes Gallici, and about 50 packets from other sources. In a large number of these specimens only usnic acid could be demonstrated. This was true of the following numbers from Sandstede's *Cladoniae* exsiccatae: 55 (the type of the species from Oldenburg), 56, 58, 59, 63, 64, 66, 68, 119, 120, 261, 295, 323, 566, 793, 794, 822, 984, 985, 1033, 1037, 1058, 1060, 1518, 1440, 1441, 1516, 1517, 1761, 1762, 1809, 1816, and 1817. The same result was obtained from 20 other specimens, giving a total of 53, or about 42 per cent of all the specimens examined. The following numbers of Sandstede's exsiccatae showed crystals of the A type, unaccompanied by either B or D: 57, 60, 61, 65, 67, 69, 117, 118, 121, 247, 402, 683, 717, 735, 795, 797, 983, 994, 1056, 1057, 1059, 1115, 1439, 1519, 1520, 1521, 1644, 1645, 1646, 1781, 1818, 1819, 1820, and 1869. Adding to these 17 other specimens in which only crystals of the A type could be demonstrated gives a total of 51. Crystals of the B type, accompanied by crystals of the A type were found in only 2 specimens, Nos. 1519 and 1647 of Sandstede's exsiccatae, representing less than 2 per cent. Nos. 324, 796, 1306, and 1696 of Sandstede's exsiccatae, together with 11 other specimens, yielded crystals of the D type, a total of 15, or about 12 per cent. In three cases both A and D were present. The number of specimens, therefore, in which crystals of the A type were demonstrated totals 56, or about 45 per cent.

Des Abbayes (**4**, p. 121) emphasizes the fact that an occasional

specimen of *C. mitis*, a typically P− species, turns yellow or pale reddish, particularly at the tips of the podetia, in the presence of this reagent. Although he mentions no definite specimens that give a yellow color, he lists the following numbers from Sandstede's exsiccatae in which he obtained a pale reddish reaction: 323, 792, 793, 994, 1056, 1603, 1748, 1750, 1761, 1820, 1860, and 1869. Seven of these are included in the lists given above and three are lacking in the writer's set of the exsiccatae, but Nos. 1603, 1860, and 1869 deserve especial mention. In No. 1603 a definite red color appeared upon the addition of P, indicating that this number (at least in part) represents *C. tenuis*, instead of *C. mitis*. No. 1860, on the other hand, gave a distinct yellow color in the presence of P and yielded characteristic crystals of psoromic acid when tested by Asahina's methods. This number was collected near Upsala, Sweden, by Hedlund in 1928. In No. 1869, which gave a similar yellow color, no crystals of psoromic acid could be demonstrated. Whether or not specimens of *C. mitis*, which give a yellow color with P, should be separated as a distinct form, comparable with *C. alpestris* f. *aberrans*, may be left for European students to decide. No specimens of this type have as yet been detected in North America.

The following numbers from des Abbayes' Lichenes Gallici showed the presence of perlatolic acid accompanied by substance B: 41 (distributed as f. *prostrata* Sandst.), 42 (distributed as f. *vesciculosa* Sandst.), 43 (distributed as f. *prostrata ad vesciculosam*) and 44 (distributed as f. *divaricata* Sandst. *ad vesciculosam*). These specimens were collected by des Abbayes in 1937 at le Pouliguen, Loire-Inférieure, France, where they grew closely intermingled. In commenting upon them Sandstede (**15,** p. 14) states that No. 42 bears a strong resemblance to "*Cl. impexa-spumosa*" and "*Cl. sylvatica-subpumosa*," implying that it is not distinguished by definite morphological features. Since perlatolic acid has not been found in any other material referred to *C. mitis* and since it represents a characteristic constituent of *C. impexa*, the writer suggests that these four numbers be transferred to *C. impexa*. The P− reaction would of course distinguish them from *C. sylvatica*, which is definitely P+.

The North American specimens in the Yale Herbarium, which have been referred to *C. mitis* are definitely P−. They fall

naturally into two groups, which differ from each other in the lichen-substances produced, in geographical distribution, and in certain morphological features. Specimens belonging in the first group do not differ materially from European material either chemically or morphologically. Some, for example, contain usnic acid only, whereas others yield in addition crystals of the A, B, or D type, either singly or in certain combinations. The material of this group exhibits a geographical distribution extending from Alaska and Arctic America southward through Canada, northern New England and northern New York to Oregon, Wyoming, Wisconsin, and Virginia.

Specimens belonging in the second group yield, in addition to usnic acid, crystals of the C type. These in some cases are accompanied by crystals of the A type but apparently never by those of either the B or D type. The range of the second group extends from the Cape Cod region southward, mostly near the coast, to Delaware, Virginia, and West Virginia. It is therefore much more restricted than that of the first group, and it may be noted also that specimens of either group rarely occur within the range of the other. The morphological features of the second group will be considered later.

The material of the first group, 186 specimens in all, includes the following specimens from exsiccati:—Merrill, Lich. exsic., No. 104, Rockland, Maine, 1909, distributed as *C. sylvatica* f. *morbida* (A). Sandstede, *Cladoniae* exsic. No. 1223, Rockland, Maine, *Merrill*, 1924 (A); No. 1469, Brandon, Vermont, *Dutton*, without date (A); No. 1476, Wareham, Massachusetts, *Robbins*, 1925 (A); No. 1749, Bourne, Massachusetts, *Robbins*, 1927 (usnic acid only); No. 1566, Jackson, New Hampshire, *Robbins*, 1924 (A, D); No. 1582, same station and collector, 1925 (A, D); and No. 1833, same station and collector, 1927 (usnic acid only). The enumeration of the other specimens may be omitted, as in the case of the North American material of *C. alpestris*, but the distribution of substances A, B and D may be summarized. Of the 186 specimens examined 125 (or about 67 per cent) showed crystals of type A, 9 (or about 5 per cent) crystals of type B, and 24 (or about 13 per cent) crystals of type D. The corresponding percentages for the European material were 45, 2, and 12. The marked discrepancy in the case of substance A is due to the fact

that the European material includes relatively more specimens containing usnic acid only, possibly because many of these specimens came from a restricted area.

The specimens examined from the Southern Hemisphere are the following:—Chile: Port Marqueri, *Junge*, 1932 (A, B). New Zealand: near Atiamuri, Allison, 1931 (usnic acid only); same station and collector, 1932, two packets (B).

In estimating the taxonomic significance of the various lichen-substances in *C. alpestris* three criteria were suggested. If the same criteria are employed in the case of *C. mitis*, it might appear that plants containing substance B or substance D had certain claims for recognition as distinct forms. Although each of these substances may accompany A, they are apparently never found together. Plants containing B, moreover, are mostly northern or antarctic and plants containing D are in many cases smaller and more delicate than plants in which this substance is lacking. The substance B, in fact, is often present in specimens representing the northern and antarctic f. *laevigata* (Vainio) des Abbayes (**4**, p. 122), in which the pseudocortex is poorly developed; and the substance D in specimens representing f. *tenuis* Sandst. (**14**, p. 110). It would therefore be a happy solution of the problem if B could be definitely associated with f. *laevigata* and D with f. *tenuis*. There are reasons, unfortunately, why this can not be done. Certain plants containing B, for example, agree neither in range nor in their morphological features with f. *laevigata*, and certain plants containing D are too robust to be referred to f. *tenuis*. It thus seems advisable, under the circumstance, to regard substances B and D, as well as substance A, as accessory constituents of *C. mitis* and to assign to them no taxonomic importance.

The case is different with specimens containing the substance C. Although the morphological distinctions between these specimens and those belonging to the first group are slight and less definite than might be desired they are sufficient in the case of well-developed material for the separation of the groups. According to des Abbayes (**4**, p. 120) the sterile ultimate branchlets of the podetia in *C. mitis* are mostly in 2's or 3's, relatively long, slender, and (in most cases) curved. These features are more or less in evidence in European material and in North

American material belonging to the first group. In material containing the substance C, however, the ultimate branchlets present a different appearance. They are not only more numerous and shorter than in the first group but the curvature tends to be less marked. Many of the branchlets, in fact, are not curved at all. The podetia, moreover, tend to be more robust than in the first group. These slight morphological differences, the restricted geographical distribution of the second group, and the fact that the presence of C apparently excludes B and D afford a sufficient basis for the separation of the group from *C. mitis* as a distinct species, as follows:—

Cladonia **submitis,** sp. nov. Thallus primarius ignotus. Podetia typice straminea vel albido-straminea, sat robusta, caespitoso-conferta, longitudine vulgo 5–7 cm., crassitudine vulgo 1–3 mm., ad axillis saepe dilatata, parce dichotome, abundantius polychotome ramosa, base divisionibus inaequalibus axem sympodialem efficentia, ramis et ramulis ramosis, ramulis superioribus abbreviatis, rectis vel rarius nutantibus, impellucida, glabra vel subverruculosa, K−, P−, acidum usnicum et materiam "C" continentia.

Although *C. submitis* is not confined to sandy localities it shows a strong preference for areas in which sand is abundant. Under favorable conditions the podetia form compact and extensive colonies, in which the more centrally situated individuals are erect or ascending. In many cases, however, the podetia are prostrate or nearly so and are either scattered about on the substratum or form loose clusters. In some cases tufts of the species grow in mats of *Polytrichum.*

The material of *C. submitis* examined by the writer includes 338 specimens and in 80 of these, representing about 24 per cent, crystals of the A type are associated with crystals of the C type in the G. E. preparations. No. 1391 of Sandstede's *Cladoniae* exsiccatae, collected by Robbins at Wareham, Massachusetts, in 1924, may be designated the type of the species. This number was distributed as *C. mitis* m. *prostrata* Sandst. Other stations for the species are as follows:—

Vermont: Brattleboro, *Evans,* 1935; Halifax, *Evans,* 1939; Marlboro, *Evans,* 1939; and Putney, *S. M. Thomson,* 1942. These specimens are less robust than most of the material from farther south. Massachusetts: Brewster, *Evans,* 1929; Provincetown, *Evans,* 1930; Stoughton, *Blake,* 1931; Manchester,

Harris and *Smith*, 1934; Eastham, *Evans*, 1935, and *Torrey*, 1936; Wellfleet, *Evans*, 1935, *Torrey*, 1937, and *Logan*, 1937; Martha's Vineyard, *Torrey*, 1936, Craigsville Beach, *Torrey*, 1936; Cape Race, *Torrey*, 1936; South Chatham, *Torrey*, 1936; Nanset Coast Guard Station, *Torrey*, 1936; Nantucket, *Torrey*, 1937, and *Sheldon*, 1940; Centerville, *Torrey*, 1937; Clinton, *Harris et al.*, 1938; and Tuckernuck, *Sheldon*, 1938. Many of these stations in the Cape Cod region. Rhode Island: South Kingstown, *Evans*, 1929. Connecticut: stations previously listed by the writer under *C. mitis* (**6**, p. 381, **7**, p. 123, **8**, p. 36, and **9**, p. 8). New York: Fisher's Island, *Evans*, 1930; numerous stations on Long Island, *Torrey*, *Latham*, and *Cain*, 1933–1939; and Croton Aqueduct near Quaker Bridge, *Torrey*, 1937. New Jersey: the stations previously listed by the writer under *C. mitis* (**10**, p. 86, **11**, p. 138, and **12**, p. 143). Delaware: Cape Henlopen and Reheboth, *Torrey*, 1936. Virginia: Short Mountain, *Allard*, 1938, and *Luttrell*, 1942; and Ironto, *Gray*, 1940, and *Luttrell et al.*, 1941. West Virginia: Petersburg, *Gray*, 1939.

The following forms of *C. submitis*, analagous to the similarly named forms of *C. mitis*, may be distinguished:—

Cladonia submitis f. **divaricata** f. nova, podetia repitito verticillate ramosa.

No. 1565 of Sandstede's *Cladoniae* exsiccatae, collected by Robbins at Wareham, Massachusetts, in 1925, and distributed as *Cl. mitis* m. *divaricata*, may be designated the type of this form. No. 1750 of the same series, collected by Robbins at the same locality, in 1927, and distributed as *Cl. mitis-divaricata*, likewise belongs here. Other records follow.

Massachusetts: Wareham, *Robbins*, 1923 and 1924; Brewster, *Evans*, 1929; Centerville, *Torrey*, 1937; and Nantucket, *Sheldon*, 1940. Rhode Island: South Kingstown, *Evans*, 1929; Watch Hill, *Evans*, 1935. Connecticut: various stations previously listed by the writer under *C. mitis* f. *divaricata* (**6**, p. 383, and **8**, p. 36). New York: Fisher's Island, *Evans*, 1930; and Long Island, Latham, 1938. New Jersey: the stations previously listed by the writer under *C. mitis* f. *divaricata* (**10**, p. 86).

Cladonia submitis f. **prolifera** f. nova, podetia vulgo decumbentia, ramulis adventiciis brevibus plus minusve numerosis tecta.

This form may be typified by No. 1564 of Sandstede's *Cladoniae* exsiccatae, collected by Robbins at North Falmouth, Massachusetts, in 1924, and distributed as *Cl. mitis* m. *prolifera*. The following additional stations may likewise be cited:—

Massachusetts: Wareham, *Robbins*, 1923; Martha's Vineyard, *Harris*, 1934, and *Torrey*, 1936; Cape Race, *Torrey*, 1936; South Chatham, *Torrey*, 1936; and Merrimack, *Harris*, 1938. Connecticut: the stations previously listed by the writer under

C. mitis f. *prolifera* (**6,** p. 383, **7,** p. 123, **8,** p. 36, and **9,** p. 8). NEW YORK: Long Island, *Torrey,* 1933, and *Latham,* 1934. NEW JERSEY: the stations previously listed by the writer under *C. mitis* f. *prolifera* (**10,** p. 86, **11,** p. 138, and **12,** p. 143). DELAWARE: Cape Henlopen, *Torrey,* 1936.

CLADONIA SUBMITIS f. **soralifera** f. nova, podetia farinoso-sorediosa, sorediis luteo-albis, in maculis circumscriptis. This form is known at present only from the following station:

CONNECTICUT: North Haven, *Miss Fulford,* 1932, previously listed by the writer (**8,** p. 37) as *C. mitis* f. *soralifera* Sandst.

DISTRIBUTION OF LICHEN-SUBSTANCES IN ALL THE SPECIES OF THE SUBGENUS CLADINA

Although several species of *Cladina* have not yet been studied critically by Asahina's methods a summary of our present knowledge regarding the distribution of the various lichen-substances found in the group may be of interest and is given in Table 1. In addition to the ten species listed by des Abbayes in his monograph (**4**) the list includes *C. pseudoevansii* and *submitis.* Following the example of its author the North American *C. tenuis* subspecies *subtenuis* des Abbayes is not separated specifically from *C. tenuis.* Of the species listed *C. leucophaea* is apparently confined to Europe and *C. pseudoevansi* to Japan. The remaining ten species have all been reported from North America, and Nos. 1, 4, 6, 8, 11, and 12 are widely distributed in other parts of the world. The sign + indicates a constant component, the sign ± an accessory component.

TABLE 1

	Atronorine	Fumarprotocetraric acid	Perlatolic acid	Psoromic acid	Rangiformic acid	Usnic acid	Substance A	Substance B	Substance C	Substance D
1. *C. alpestris* (L.) Rabenh.			±	±		+	±	±	±	
2. *C. Evansi* des Abbayes	+		+							
3. *C. fallax* des Abbayes		+				+				
4. *C. impexa* Harm.			+			+		±		
5. *C. leucophaea* des Abbayes		+								
6. *C. mitis* Sandst.				±	±	+	±	±		±
7. *C. pseudoevansi* Asahina			+			+				
8. *C. rangiferina* (L.) Web.	+	+								
9. *C. Sandstedei* des Abbayes	+	+								
10. *C. submitis* Evans						+	±		+	
11. *C. sylvatica* (L.) Hoffm.		+				+	±			
12. *C. tenuis* (Floerke) Harm.		+				+	±			

Literature Cited

1. Asahina, Y. Mikrochemischer Nachweis der Flèchtenstoffe (II. Mitteil.). Jour. Jap. Bot. **12**: 859–872. 1936.
2. ———. Mikrochemischer Nachweis der Flechtenstoffe. V. Mitteilung. *Ibid.* **14**: 39–44. 1938.
3. ———. Mikrochemischer Nachweis der Flechtenstoffe. XI. Mitteilung. *Ibid.* **16**: 185–193. 1940.
4. Des Abbayes, H. Revision monographique des *Cladonia* du sousgenre *Cladina* (Lichens). Bull. Soc. Sci. Bretagne **16** (fasc. 2): 1–156. 1939.
5. Duvigneaud, P. Notes de microchemie liquénique, I. Sur deux *Cladoniacées* nouvelles. Soc. Roy. de Bot. de Belg. Bul. **71**: 192–198. 1939.
6. Evans, A. W. The *Cladoniae* of Connecticut. Conn. Acad. Arts and Sci. Trans. **30**: 357–510. 1930.
7. ———. Notes on the *Cladoniae* of Connecticut. Rhodora **34**: 121–142, 153–164. 1932.
8. ———. Notes on the *Cladoniae* of Connecticut—II. *Ibid.* **37**: 33–57. 1935.
9. ———. Notes on the *Cladoniae* of Connecticut—III. *Ibid.* **40**: 4–26. 1938.
10. ———. The *Cladoniae* of New Jersey. Torreya **35**: 81–109. 1935.
11. ———. The *Cladoniae* of New Jersey—Supplement. *Ibid.* **38**: 137–149. 1938.
12. ———. The *Cladoniae* of New Jersey—Second Supplement. *Ibid.* **40**: 141–165. 1940.
13. ———. Asahina's microchemical studies on the *Cladoniae*. Torrey Bot. Club Bull. **70**: 139–151. 1943.
14. Sandstede, H. Die *Cladonien* des nordwestdeutschen Tieflandes und der deutschen Nordseeinseln. III. Abhandl. Naturw. Ver. Bremen **25**: 89–243. 1922.
15. ———. Ergänzungen zur Wainio's "Monographia *Cladoniarum* universalis" unter besonderer Berücksichtigung des Verhaltens der *Cladonien* zu Asahina's Diaminprobe. Repert. Spec. Novarum Regni Veg. Beih. **103**: 1–103. 1938.
16. Zopf, W. Beiträge zu einer chemischen Monographie der *Cladoniaceen*. Deut. Bot. Gesell. Ber. **36**: 51–113. 1907.

CARUNCULATE SEED DISSEMINATION BY ANTS

Burton N. Gates

The caruncle-bearing seeds of the Large White Trillium and of the Bloodroot, have been shown to be disseminated by ants.[1] They are attracted by the caruncle, as a lure and a probable source of food. It was observed that the seeds were carried into the ants' nest, the caruncle removed, and the denuded seeds discarded outside of the nest. This the writer reported in Rhodora.

[1] Burton N. Gates, Dissemination by Ants of the Seed of *Trillium grandiflorum*. Rhodora, 1940. vol. 42, p. 194.

Ibid. Observations in 1940 on the Dissemination by Ants of the Seeds of *Trillium grandiflorum*. Rhodora, 1941, vol. 43, p. 206.

Ibid. Dissemination by Ants of the Seeds of Bloodroot, *Sanguinaria canadensis*. Rhodora, 1942, vol. 44, p. 13.

From these observations, it was anticipated that other caruncle-bearing seeds, likewise attract ants as a food source and are ant-dispersed. By examining many kinds of seeds, a few were found with a caruncle. These were tested with ants for their reactions. The same general methods have been employed, as with the Trillium and the Bloodroot. All seeds were freshly gathered and handled with forceps to minimize contamination with foreign odors. These experiments were made at Worcester, Massachusetts.

Ricinus species

The Castor bean, *Ricinus sp.*, an exotic plant is generally known to have a huge caruncle. This foreign seed, it might be anticipated, would have no attraction for New England, common ant-species. Its habitat is considered to be Africa; possibly it is indigenous to tropical America and Asia. It is grown in the north-temperate zone for ornament, though not extensively. With it, our native ants can have had little more than a limited and recent experience. It is popularly thought to have properties repellent or perhaps poisonous to insects and animals. Beans placed in the tunnel of a mole are said to be repellent and poisonous. While gathering freshly ripened beans, a gardener told the writer, "ants never go near the Castor bean plants."

As a test, freshly collected beans were offered to various, undetermined ants on October 4, 1941, at several stations. Although the ant reactions were not absolutely negative, for a time it appeared that this carunculate seed might prove unattractive. Seemingly indifferent, some ants were seen to explore the seed and to tap the bean and caruncle with their antennae. To further test this slight reaction, and, because the seed is so mountainous as compared with the size of most of our common ants, the caruncle was removed and offered separately. This resulted in increased activity, but there was no apparent effort to carry off the caruncle. Finally, the hard, fibrous caruncle was crushed and broken with forceps. A trial piece brought immediate response; an ant carried away the first piece offered. Crushing doubtless expressed or released some of the oils which are thought to be the food elements in the caruncle which attract the ants. In succeeding trials, each ant which carried off a

piece of caruncle was caught for identification. The nine collected ants proved to be of one species, *Prenolopis imparis* Say.[1]

The reaction of the New England ants to the tropical Castor bean caruncle would indicate that in its native habitat, it too is a lure to ants in the dissemination of the seeds. It is the usual practice for an ant to carry the seed to the nest with the attached caruncle. Due to the disproportionate size of our ants to the greater bulk and weight of the seed of the Castor bean, the predominately small ant species, commonly found in this locality could hardly be expected to attempt this feat. On this feature Mr. Wesson commented in a letter, that in the tropics, where there is a wealth of ant species, "there would be many strong enough to transport this bean." He also ventured that in our northeastern States "this bean could be transported, although not with facility, by some members of the genera *Formica* and *Camponotus*". Although not yet demonstrated, it would appear from the ant reactions that the beans of the Castor bean plant in their natural habitat, doubtless may be disseminated by ants.

Viola

Various species of *Viola* seeds were found to be carunculate. Cleistogamous seeds of *Viola cucullata* Ait. on October 5, 1941 were ripening freely. During the warm part of the day, ants were working in and out of their nests. At the first station in a dirt path, where an experiment with these seeds was attempted, it was a surprise to find that the ants of this nest had already gathered violet seeds (doubtless *V. cucullata*). Resting lightly on the sandgrain cone of the entrance, apparently having been cast from the nest within the last few hours, twenty-four *Viola* seeds were picked up with the forceps. The caruncle of each seed had been gnawed off, a confirmation of ant behavior as determined in the early experiments with Trillium seeds. Three specimens of the ants of this nest, which had ejected the *Viola* seeds were identified by Mr. Wesson as *Lasius americanus*.

At a second station freshly gathered *Viola* seeds were placed adjacent to a small entrance. The head of an entrance-guard could be seen, practically closing the hole. As if by magic, the seeds disappeared into the nest, one by one. The guard was seen

[1] Mr. Lawrence G. Wesson, Jr., Boston, Massachusetts has generously made ant determinations in all of these experiments. His assistance is appreciated.

to emerge slightly, pick up a seed and disappear so quickly with it, that she virtually defied detection. Nine seeds were hastily taken in this way; the tenth was stolen and carried off by a strange ant. She was traced to her entrance, about two feet away, into which she disappeared with the seed. Two specimens from this nest were identified by Mr. Wesson as *Prenolopis imparis*.

Chelidonium majus

Celandine, *Chelidonium majus* L., was found on June 13, 1942 to be ripening seeds which were carunculate. They are small, about 1 mm. the long way. At the first station, seeds were shelled from a pod on to a flat stepping-stone where ants were crossing. The seeds at first attracted little attention; one small ant picked up the same seed on two occasions, carried it a short distance and dropped it. This hesitation was also observed on several occasions in the course of the trials. A slightly larger ant found the seeds and carried away eight of them in quick succession. Apparently, this was done by the same individual, judging from her searching behavior and her haste to find more seeds. No identification of the ant species was attempted in these tests with the Celandine seeds, the behavior being so uniform with that of the various species identified by Mr. Wesson.

At the second station, four seeds were promptly picked up from the dirt path. Seven to ten ants when offered a slightly opened pod placed on the ground, endeavored to extract seeds through the opening. At the third station, a pod which had been partially split open was placed on a path. Several ants of a larger species attacked it, forcing their way into and enlarging the cleft. In a brief period, ten seeds were removed and carried a short distance to the nest.

Referring to the first trials with Celandine seeds, several ants were observed to hesitate, as if to examine the seed which they had clutched. In some instances the seed was dropped and picked up again by the returning ant. Usually, it was carried away after a more or less extended examination. While no positive interpretation seemed possible, this behavior suggests either an unfamiliar food material, requiring some sort of determination by the ant, or an undetected attempt to remove the caruncle in the field. There is evidence of a process of

learning or becoming acquainted with a new and satisfactory food. Having recognized the good food, there appears to be a means of announcing the "find." The first Celandine seeds taken into the nest noticeably increased the nest activity at the entrance. Excitement was evident as ants hurried out in increased numbers, quite comparable to a recognized behavior of honeybees. It has been demonstrated that bees have a means of announcing a new "find" to the other workers in the hive, which results in increased hive-activity and a rush from the entrance. The ant behavior was quite comparable, as soon as the first few Celandine seed passed into the nest; excitement around the entrance was manifest. More and more ants emerged; more and more ants attempted to force their way into the split in the Celandine pod, removing seeds about as fast as they could be counted. By some means, the "find" of a quantity of Celandine seeds had become known quickly, to many workers.

Dicentra spectabilis

Bleeding Heart, *Dicentra spectabilis* Lem. (sometimes called *Dielytra spectabilis* in horticulture), self-sows widely in the writer's garden, suggesting to Mrs. Gates that this plant, like *Viola* and some weedy species might be disseminated by ants. She confirmed this August 30, 1942. The seeds are a glistening, polished black having a proportionately large "crest", as termed in Gray's Manual of Botany. The first seed which Mrs. Gates offered an ant was instantly taken; simultaneously, one she had placed on a stepping-stone disappeared. She fed various ants a pod of five seeds within a few minutes. All were readily accepted. The only other pods which could be found were not quite ripe. Slightly unripe seeds, lacking the lure, which may be odor, flavor, consistency, immaturity of the caruncle or some other quality, have no attraction for ants. This also has been observed with other species of seeds, in particular with Celandine seeds. August 31 a ripe pod was found. The seeds were offered to ants at a number of different stations. Because of the shortage of seeds at this late season, a few of them were recovered and used in more than one trial. Three positive reactions, each at a different station, were immediately obtained. At one station, an ant climbed into the match box in which the seeds were being carried,

stole a seed and made away with it before she could be captured. A series of seven positive reactions were then obtained; the fourth subject, however behaved unusually. This ant spent considerable time in an apparent effort to remove the carunculate "crest". She finally gave up the task and carried away the whole seed. Should this become a usual practice in the field, obviously, the primary function of the caruncle to bring about seed dispersal would be defeated. On the contrary, among the many observations, practically every ant appeared to be impelled to pick up the seed and carry it away in the greatest haste.

Summary

In mentioning the caruncle, the fact that a seed may have a minute, not visible caruncle has been disregarded. For the purpose of these experiments, a carunculate seed has a pronounced caruncle, visible and presumed to be ant food. In the search for carunculate seeds, all kinds of seeds have been examined. This has been necessitated, because the caruncle is seldom mentioned or indicated in taxonomic keys, as Gray's Manual. It appears possible, however, that seed characters, including the caruncle could be used to advantage in plant classification. For instance, the seeds of all Violas (no mention in Gray) thus far examined are carunculate: these caruncles and seeds appear to differ with the species and may be of taxonomic value.

In order to bring together and visualize these findings, a list of the seeds observed with a pronounced caruncle or aril, as well as those mentioned by Gray or elsewhere has been arranged; seeds used in the experiments with ants are indicated by an asterisk(*).

Family	Carunculate Trend	Species observed with Caruncle
Liliaceae	Various genera with caruncle and aril	**Trillium grandiflorum* (Michx.) Salisb.
Nymphaeaceae	Ariled seeds in genus *Castalia*	
Anonaceae	Ariled	
Berberidaceae	With and without aril	

Family	Carunculate Trend	Species observed with Caruncle
Papaveraceae	Many species with caruncle or crest	**Sanguinaria canadensis* L. **Chelidonium majus* L. *Macleaya cordata* (Willd.) R. Br.
Fumariaceae	Genera and species vary with and without crest, caruncle or aril: factors used in classification	**Dicentra spectabilis* Lem.
Polygalaceae	Species largely caruncu-late: used in classification	
Euphorbiaceae	Various genera and species with caruncle; used in classification	**Ricinus* sp. (probably *communis*)
Celastraceae	Mostly ariled	
Violaceae	Not mentioned in Gray's Manual (Seventh ed.) as carunculate. Caruncle seeds of *Viola blanda, incognita,* and *renifolia* are illustrated in Baird—Wild Violets of North America, Berkeley, 1942, p. 160, but no mention is made in the text of the caruncle.	*Viola pedata* L. **cucullata* Ait. " forms, (two white-flowered forms in cultivation) *palmata* L. *fimbriatula* Sm. *lanceolata* L. *pallens* (Banks) Brainerd *blanda* Willd. *incognita* Brainerd *renifolia* Gray *odorata* L. (A single, white form with violet markings; fragrant) *pubescens* Ait. *tricolor* L. (Cultivated pansy) *tricolor* L. ("Johnny-Jump-up") *arvensis* Murr. "Jersey Gem", a horticultural variety

Ant Species and the Species of Carunculate Seeds to which Ants reacted

During the tests covering several years, eight species of ants have responded to the caruncle of six species of seeds. As will be observed in the tabulation, a given species of ant reacted to one or to more than one species of seed. Since the tests were made at random, there is no indication that an ant species selected or

refused any particular species of seed. Instead, had it been possible to make the tests, it is not unlikely that the various ants would have responded to any of the various caruncles. It is likewise presumable that other ant species and other carunculate seeds would give comparable results.

Ants	Plants with Carunculate Seeds to which Ants reacted
Camponotus herculeanus pennsylvanicus	*Trillium grandiflorum* (Michx.) Salisb.
Formica fusca subsericea	*T. grandiflorum*
Formica neogagates var.	*T. grandiflorum, Sanguinaria canadensis* L.
Lasius americanus	*S. canadensis, Viola cucullata* Ait.
Lasius niger var. *americanus*	*T. grandiflorum*
Myrmica emeryana	*S. canadensis*
Myrmica fracticornis	*T. grandiflorum*
Prenolepis imparis	*Ricinus* species, *V. cucullata*

Observations thus far indicate that carunculate seeds are for the most part of the drop-seed type, *Viola* being an exception. (The mechanical dispersal in *Viola* is accomplished by means of the lengthwise closing of the valves of the capsule, as it opens and dries, ejecting the seeds. Ants may carry them a much greater distance, accomplishing wider dispersal.) Dissemination by ants, in the New England flora, has proven more general than was at first thought, when tests with *Trillium* seeds were made. The interrelation of ants and of carunculate seeds may be even more widespread than is now presumed. In general, ants and carunculate seeds may be interdependent: this, in fact, may be cosmopolitan.

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VIRGINIAN BOTANIZING UNDER RESTRICTIONS

M. L. Fernald

(*Continued from page 413*)

Tiarella Wherryi Lakela in Am. Journ. Bot. xxiv. 344, pl. 1 (1937), including *T. cordifolia*, var. *collina* Wherry, Not. Nat. Acad. Sci. Phil. no. 42: 3 (1940) and *T. cordifolia*, subsp. *collina* (Wherry) Wherry, l. c. 4 (1940). To the counties already recorded (Amelia, Mecklenburg, Henry and James City) add the following. Bedford County: May 7, 1871, *A. H. Curtiss.*

Brunswick County: bluffs of Meherrin River, near Westward Mill, May 4, 1942, *J. B. Lewis*, no. 3410; rich wooded bluffs below Western Bridge, Meherrin River, south of Edgerton, October 12, 1942, *Fernald & Lewis*, no. 14,482. See pp. 379, 380.

I get no satisfaction in trying to separate from *Tiarella Wherryi*, described from Tennessee, southwestern North Carolina and Alabama, the non-stoloniferous plant found from the Blue Ridge eastward to the Coastal Plain. According to Wherry, l. c., "*T. Wherryi* differs in flowering later, in the stems usually bearing one or more leaves, and in the acutish sepals rarely being over 2 mm. long and 0.75 mm. wide", whereas his *T. cordifolia*, var. *collina* (type from Henry County, Virginia) has the "leaves similar to those of var. *austrina* . . . in tending to be longer than wide, and in having the marginal teeth broad with shallow sinus; flowers appearing in spring; flowering stems normally leafless; sepals oblong, obtuse, 2.5–3.5 by 1.5 mm."

Stoloniferous northern *Tiarella cordifolia* has the leaves so variable in outline that it is quite easy to find specimens from Maine, New Hampshire and other northern states and from Quebec, New Brunswick and Ontario with leaves inseparable in outline and toothing from those of southern plants cited as var. *austrina* Lakela or as var. *collina*. As defined by Wherry vars. *austrina* and *collina* have the leaves "tending to be longer than wide", while *T. cordifolia* var. *typica* has, according to him, the leaves "tending to be about as long as wide". As already stated, in New England, where var. *typica* alone is supposed to grow, leaves positively longer than wide are common: 5.3 cm. long, 3.6 cm. wide; 6 cm. long, 4.5 cm. wide; 6.5 cm. long, 5 cm. wide; 8 cm. long, 6 cm. wide; 9 cm. long, 7 cm. wide; 9.5 cm. long, 7 cm. wide; 10 cm. long, 9 cm. wide; 10.3 cm. long, 8.3 cm. wide; 11 cm. long, 7.3 cm. wide; 14 cm. long, 11 cm. wide. When, furthermore, we find that many specimens of the nonstoloniferous var. *collina* "foliis var. *austrina* similis" have leaves nearly or quite as broad as long (Amelia Co.: 8 cm. long by 7.4 cm. wide and 11 cm. long by 9.6 cm. wide; Brunswick Co: 7 cm. long by 6.5 cm. wide, 6.5 cm. long by 7 cm. wide, 7.3 cm. long by 7.5 cm. wide, 10 cm. long by 9.5 cm. wide; Durham County, North Carolina: 9 cm. long by 7.8 cm. wide or 9.5 cm. long by 8.5 cm. wide), it is evident that the difference in proportion is of less significance

than assumed. As for size, the maximum given in the original description of *T. Wherryi* is 14 cm. long and 9 cm. wide; but plenty of New England specimens of *T. cordifolia,* var. *typica* have leaves 10–14 cm. long and 9–11 cm. broad, while in the nonstoloniferous Piedmont *T. cordifolia,* var. *collina* full-grown leaves are essentially the same size; and surely the leaf of *T. Wherryi* was originally described as longer than wide, "folia laminis elongato-ovatis . . . 7–14 cm. longis 6–9 cm. latis" and the type-sheet, as shown by the memorandum on Dr. Lakela's photograph (her plate 1) of it, was originally taken by her to be merely a southern variety of *T. cordifolia.*

As to the bract or bracts on the scape, I am unfortunate in not having before me the large series of Dr. Wherry's material of *T. Wherryi,* which is said to differ from his *T. cordifolia,* var. *collina* in "having the stems usually bearing one or more leaves". If, as appears from the original account of *T. Wherryi,* that species is the nonstoloniferous plant of Tennessee and Alabama, it would seem that the considerable series of such plants from those states which has accumulated in the Gray Herbarium and at the New York Botanical Garden should be *T. Wherryi.* The difficulty is, that in this series, including plants from Tuscaloosa County and other areas cited in the original description "caules floriferi . . . nudi vel 1–3 foliis parvis instructi", only 6 scapes show bracteal leaves (in each case solitary), while 47 scapes are bractless. From the station in Brunswick County, Virginia, of what should be naked-scaped *T. cordifolia,* var. *collina,* one of Mr. Lewis's specimens has a well developed leaf on the scape, while a similar specimen from near Raleigh, North Carolina (*Godfrey,* no. 3424) shows bracted scapes. Incidentally, it is notable that Dr. Lakela's illustration of the type of *T. Wherryi* shows only *naked* scapes.

Coming to the reputed difference between the sepals of *Tiarella cordifolia* (var. *collina*) and *T. Wherryi:* the former with "sepals obtuse, 2.5 to 3.5 by 1 to 1.5 mm.", the latter with "the acutish sepals rarely being over 2 mm. long and 0.75 mm. wide", it seems from the material assembled in the Gray Herbarium that too much stress has been given these points. Material from Tuscaloosa County, Alabama, has blunt sepals 3 mm. long and 1.3 mm. broad, while *T. Wherryi* from Grundy County and from Marion

County, Tennessee, *Svenson*, nos. 7653 and 10,056 respectively, shows the sepals quite obtuse. Desiring a check on my own measurements, I asked, without telling him my results, the very accurate Dr. Robert C. Foster to measure under his binocular some selected specimens. His (and my) measurements give the following results, the specimens all being in late anthesis. *T. Wherryi* from Cumberland County, Tennessee, *C. A. and Una F. Weatherby*, no. 6249, sepals 2.3–2.6 mm. long; from Marion County, Alabama, *E. J. Palmer*, no. 38,997 (as *Heuchera villosa*), sepals 2.3–2.4 mm. long. *T. cordifolia*, var. *typica* from Wilton, New Hampshire, May 11, 1886, *M. A. C. Livermore*, sepals 2–2.2 mm. long; from Charlemont, Massachusetts, May 15, 1915, *Churchill & Woodward*, sepals 2.4–2.6 mm. long; from Becket, Massachusetts, *Fernald*, no. 15,172 (type of forma *parviflora*), sepals 1.8–2.2 mm. long. Since northern stoloniferous *T. cordifolia* may have the sepals down to 1.8 mm. long, while southern nonstoloniferous *T. Wherryi* may have them up to 3 mm. long and 1.3 mm. wide (as well as obtuse), I find myself unable to recognize a specific difference in the sepals.

Dr. Wherry finds that from his Piedmont and Coastal Plain *Tiarella cordifolia*, var. *collina* "The likewise non-stoloniferous *T. wherryi* differs in flowering later", and it is a very striking fact that the type of *T. Wherryi* in young anthesis was collected in Polk County, Tennessee, on June 12. The type-station is a ravine of Hiwassee Beach, between the Unaka Mountains and Beans Mountain, consequently relatively cool and backward. If the non-stoloniferous plants of Tennessee and Alabama are, as seems to be the case, *T. Wherryi*, it becomes important to note the flowering period of other specimens. Tennessee: Sevier County (Gatlinburg, not far from the Great Smoky Mountains), April 27, *Sharp*, in flower; Knoxville, Knox County, May 29, *Ruth*, no. 341, fruit and lingering flowers; Cumberland County, May 12, *Weatherby & Weatherby*, no. 6249, fruit and last flowers; Grundy County, alt. 1500 ft., April 27, *Svenson*, no. 7653, flowers; Marion County, May 13, *Svenson*, no. 10,056, flowers; Cheatham County, April 24, *E. J. Palmer*, no. 35,506, flowers. Alabama: Tuscaloosa County, April 19, *Harper*, no. 3490, flowers; Marion County, April 21, *E. J. Palmer*, no. 38,997, flowers. When we take the flowering material of the non-

stoloniferous plant from the Blue Ridge east to the Coastal Plain which has come to the Gray Herbarium we get the following score. VIRGINIA: Amelia County, May 2, *J. B. Lewis*, no. 87, flowers; May 21 *Lewis*, no. 89, young fruit and lingering flowers; Brunswick County, May 4, *Lewis*, no. 3410, buds, flowers and young fruit; Henry County, May 6, *Baldwin*, no. 242, flowers. NORTH CAROLINA: Durham County, April 12, *Correll*, no. 5049, flowers; May 4, *Godfrey*, no. 3809, young fruit with lingering flowers; Wake County, April 11, *Godfrey*, no. 3424, flowers; Mecklenburg County, April 26, *C. H. Knowlton*, buds and young flowers. From these facts it can only be surmised that Dr. Wherry's series of later-flowering *T. Wherryi* came from cooler habitats than much of the material collected by others.

Tiarella Wherryi was distinguished by Dr. Lakela by the "fructus carpellis 5–10 mm. longis . . . abrupte rotundatis ad rostellum angustum". Here is a real morphological character which seems to hold, and all the mature fruit of the Piedmont and Coastal Plain plant before me has the short and broad round-tipped valves. Northern and typical *T. cordifolia*, on the other hand, has the fruit often more elongate, 6–12 mm. long, the relatively narrow valves more lance-oblong and gradually tapering to subacuminate at tip. The stoloniferous typical *T. cordifolia*, furthermore, has the lower fruiting pedicels 7–13 mm. long; the lower pedicels of the nonstoloniferous southern series are somewhat shorter (6–10 mm. long). In typical *T. cordifolia* the tip of the filament (after disarticulation of the anther) is relatively blunt; in the nonstoloniferous southern plant the filament is more slenderly tapering at summit. All in all, the short and round-tipped fruit and the slight differences in length of pedicels and in tip of filament mark a southern nonstoloniferous plant, *T. Wherryi*, as distinguished from a more northern stoloniferous one, *T. cordifolia*. Differentiation of the nonstoloniferous plants from east of the Alleghenies from a similar plant, with inseparable technical characters but occurring west of the Alleghenies, seems artificial. It is reminiscent of the artificial separation of like plants as two species, one occurring "east of the Continental Divide", the other west of it, or the too familiar key-characters, "eastern" versus "western".

*Philadelphus inodorus L. Caroline County: steep wooded bluff by Rappahannock River, northeast of Return, *Fernald, Long & Fogg*, no. 14,168, spread from cultivation. See p. 358.

Hamamelis virginiana L., var. parvifolia Nutt. Local range extended into Southampton County: dry woods near Johnson's Millpond north of Sedley, nos. 14,336 and 14,337, strongly contrasting with typical *H. virginiana* growing with it.

*× Pyrus Lecontei Rehder (*P. communis* L. × *pyrifolia* (Burm.) Nakai). Princess Anne County: large shrubs persisting in clearing about old house, Cedar Island, no. 12,361. Essex County: border of dry woods northeast of Loretto, *Fernald, Long & Abbe*, no. 14,169. Southampton County: border of woods 1 mile south of Branchville, no. 10,277.—Identifications kindly supplied by Professor Rehder, who informs me that this hybrid was extensively introduced by Le Conte.

*Malus angustifolia (Ait.) Michx., var. puberula Rehder. Surry County: dry oak and pine woods southwest of Spring Grove, *Fernald, Long & Abbe*, no. 14,170; dry oak and pine woods southwest of Savedge, *Fernald, Long & Abbe*, no. 14,171, tree 25 feet high, with trunk 6 inches in diameter. Identifications kindly supplied by Professor Rehder, who states that the only material he had previously seen was from Louisiana and Mississippi.

Although I here enter *Malus angustifolia* as a species of *Malus* in deference to Professor Rehder who made the identifications, the so called generic distinctions between the subgenera or sections of *Pyrus* sensu DeCandolle, Endlicher, Bentham & Hooker, Focke, Engler & Prantl, Gray, Bailey and others are no different now than they were when those students of worldwide relationships treated them as all belonging in the single genus *Pyrus*. In Rehder's Manual, ed. 2, the key to genera gives these distinctions:

Styles connate at base: fr. usually apple-shaped, without or with few grit-cells.....26. *Malus*.
Styles free: fr. usually pear-shaped, its flesh with numerous grit-cells.....30. *Pyrus*.

Much hangs on the shape of an apple, whether the depressed-globose of the old fashioned Russet or the elongate ovoid of a Gilliflower. Similarly, although the obovoid form of most of our commonly cultivated pears is familiar, one has to look no farther than Hedrick's Pears of New York to see beautiful life-sized plates of ovoid to globose pears: globose-ovoid, suggesting a

Hubbardston apple, in *Pyrus serotina;* globose as a cherry in *P. betulaefolia;* depressed-globose, like a conventional apple, in "Gansel Seckel" and even more depressed in "Idaho". In fact, of the Pears treated in Rehder's Manual ("fr. usually pear-shaped") 13 out of the 15 species have the fruit described as "globose" "globular" "subglobose" or "ovoid"; while such a species as *Malus Halliana* is described in Rehder's key as having "fr. pyriform". The terms "apple-shaped" and "pear-shaped" thus become a bit vague. Since, furthermore, two sections of *Malus*, as accepted by Rehder, have grit-cells, we get down to styles connate at base in *Malus*, free in *Pyrus*, and another character: "lvs. . . folded or convolute in bud" in *Malus*, "involute in bud" in *Pyrus*. These, if absolutely constant, are much sounder characters than shape of fruit. I have not sufficient knowledge of the many species to be sure whether these characters are absolute. Many wise taxonomists of the past and the present have doubted their value as full generic differences, when there is so much variation in other characters. It is often said that apples and pears do not hybridize; that that is a sure test. Therefore, since *Sorbus* and *Aronia* do hybridize, keep them apart as genera and set up a new genus, × *Sorbaronia* Rehder, for their hybrid offspring, just as the genus × *Sorbopyrus* has been set up for the hybrid of *Pyrus communis* and *Sorbus aria*. Neither the failure of some groups to cross nor the occurrence of crosses between ordinarily quite distinct genera is the final test. So many proven cases of incompatability within genera have been noted that one can hardly argue that incompatibility necessarily demonstrates distinctness of genera; and when such utterly unrelated genera as *Cyperus* and *Rhynchospora* have sometimes crossed, producing × *Cyperus Weatherbianus* Fern., we do not merge the two genera.

If *Pyrus, Malus, Sorbus* and *Aronia* are distinct genera are not *Azalea* and *Therorhodion* equally separable from *Rhododendron; Polycodium* and *Cyanococcus* from *Vaccinium; Amygdalus* and *Cerasus* from *Prunus*? These subgenera have quite as many and as sound morphological characters. I am inclined to follow DeCandolle, Endlicher, Bentham & Hooker, Focke, Engler & Prantl, Gray and Bailey until much stronger cases are presented for the generic segregation of Pyrus in its inclusive sense. Mor-

phologically its elements are no more discordant than those of *Pinus* and *Quercus*.

*Psoralea psoralioides (Walt.) Cory, var. eglandulosa (Ell.) F. L. Freeman in Rhodora, xxxix. 426 (1937). Dinwiddie County: low open pineland, thickets and clearings just east of McKenney, no. 14,346. First from northeast of western South Carolina. See p. 366.

*Tephrosia virginiana (L.) Pers., var. glabra Nutt. ex Torr. & Gray, Fl. N. Am. i. 296 (1838). Hanover County: dry pine woods south of Ashland, no. 7460. Isle of Wight County: clearing in damp sandy pine barrens, south of Zuni, no. 14,345. Southampton County: dry sand of pine barrens about 7 miles south of Franklin, nos. 7459 and 7461. See p. 369.

Tephrosia virginiana, var. *glabra*, originally described from Georgia, occurs also in pine barrens or on sand-ridges of South Carolina (Clarendon County, *Godfrey & Tryon*, no. 1021) and in New Jersey. Whereas typical and wide-ranging *T. virginiana* has the internodes and leaf-rachises more or less villous, the villi either few or very numerous, the lower surfaces of the leaflets pilose to sericeous and the legume copiously long-villous, the internodes and rachises of var. *glabra* are at most closely short-hispid and often glabrate, the leaflets sparsely strigose to glabrous beneath and the legumes closely silky-strigose, not copiously villous. In eastern Virginia it seems to be the pine-barren extreme.

Recently some students have indicated the occurrence in the Atlantic States (New England and New York to South Carolina) of var. *holosericea* (Nutt.) Torr. & Gray, l. c., based on *T. holosericea* Nutt. in Journ. Acad. Sci. Phila. vii. 105 (1834) and I find many specimens in the Gray Herbarium from these states marked over as var. *holosericea*. So far as I can see they are nearly if not quite typical *T. virginiana*, the individuals with a few pin-point trichomes to be found on the upper surfaces of some leaflets. Nuttall's plant was a more definite variation than this: "whole plant sericeous, scarcely excepting the upper surface of the leaves. *Hab.* In the plains of Arkansas."—*Nuttall.* Torrey & Gray correctly defined it: "stem and raceme densely villous; leaflets very silky-pubescent on both sides". If we keep to the original accounts and restrict var. *holosericea* to the plants with "leaflets very silky-pubescent on both sides" (*i. e.* above as well as be-

neath) that variety assumes an inland range, from Michigan and Wisconsin to Texas, and we do not have to oversort the plants of the Atlantic States.

*Glycyrrhiza lepidota Nutt., var. glutinosa (Nutt.) S. Wats. Brunswick County: fallow field back of old Chamblis Place, Seward Forest, near Triplett, no. 14,483. A large patch, spreading extensively by long subterranean rootstocks, doubtless originally cultivated. This is the western extreme with glutinous foliage, the stems covered with stout glands and viscid setae. See p. 378.

Vicia caroliniana Walt. Local range extended northward to Dinwiddie County: low open pineland, thickets and clearings just east of McKenney, no. 14,350. See p. 365.

Polygala Senega L., var. latifolia Torr. & Gray. Brunswick County: oak-hickory woods back of old Chamblis Place, Seward Forest, near Triplett, *Fernald & Lewis*, no. 14,484; the first from the southeastern section of the state. See p. 378.

P. sanguinea L. To the few and scattered stations in southeastern Virginia add a second one in Dinwiddie County: low open pineland, thickets and clearings just east of McKenney, no. 14,355. See p. 366.

*Euphorbia corollata L., var. paniculata (Ell.) Boiss. Henrico County: open thicket, South Richmond, no. 12,711. Extension north from North Carolina.

Acer floridanum (Chapm.) Pax. Brunswick County: very abundant in rich woods near Western Bridge, Meherrin River, south of Edgerton, *Fernald & Lewis*, no. 14,487. See p. 379.

Aesculus neglecta Lindl., var. pubescens Sargent. Greensville County: in great abundance in rich woods along Meherrin River, below Emporia, *Fernald & Lewis*, no. 14,537. See p. 383.

Previously misidentified from meagre shrubs farther down and to the north of the river as *Ae. discolor* Pursh, which should be dropped from the Virginia list.

Hypericum denticulatum Walt., var. ovalifolium (Britt.) Blake. To the few and remote stations add one in Southampton County: moist sandy and peaty shore of Whitefield's Millpond, southwest of Corinth, no. 14,366. See p. 373.

H. setosum L. Range extended inland to Brunswick County: wet level opening in flat woods, 1½ miles southeast of Triplett, August 18, 1942, and swampy old field south of Seward Forest, Triplett, August 5, 1943, *J. B. Lewis*. See pp. 374–376.

Viola cucullata Ait. Very local on or near the Coastal Plain southward. The following are our only stations. King

and Queen County: magnolia swamp about 2 miles northeast of St. Stephen's Church, *Fernald, Long & Abbe*, no. 14,203. Surry County: low woods, Cypress Swamp, near Sexton, *Fernald, Long & Abbe*, no. 14,204. See p. 358.

V. lanceolata L. To the few stations inland from the coast add one in Isle of Wight County: muddy and swaley shore, Darden's Pond, southeast of Collosse, no. 14,367.

V. lanceolata, var. vittata (Greene) Weath. & Grisc. To the few recorded stations add one in Southampton County: moist sandy and peaty shore of Whitefield's Millpond, southwest of Corinth, no. 14,368. See p. 373.

V. striata Ait. A second Coastal Plain station, this one in Greensville County: rich woods along Meherrin River, below Emporia, *Fernald & Lewis*, no. 14,538. See p. 383.

Rhexia ventricosa Fern. & Griscom. Range extended inland to Dinwiddie County: ditch bordering low open pineland just east of McKenney, no. 14,369. See p. 366.

*Oenothera tetragona Roth, var. riparia (Nutt.) Munz. Dinwiddie County: low open pineland, thickets and clearings just east of McKenney, no. 14,370. First from north of Wilmington, North Carolina. See p. 366.

Proserpinaca intermedia Mackenz. To the recorded Virginia station (near Lee Hall) add one in Southampton County: moist sandy and peaty shore of Whitefield's Millpond, southwest of Corinth, no. 14,373. See p. 373.

*Eryngium prostratum Nutt. Southampton County: moist sandy and peaty shore of Whitefield's Millpond, southwest of Corinth, no. 14,375. First from north of South Carolina. Identification tentative, the young fruit showing characters not surely matched in *E. prostratum*. Mature material is needed. See p. 373.

Zizia trifoliata (Michx.) Fern. (*Z. Bebbii* (C. & R.) Britt.). Brunswick County: oak-hickory-beach woods back of old Chamblis Place, Seward Forest, near Triplett, *Fernald & Lewis*, no. 14,489. First from east of the mountains. See p. 378.

*Sium floridanum Small. Southampton County: wooded bottomland of Blackwater River, southeast of Ivor, no. 13,710, the arching or lopping stems left stranded after submergence and proliferating, the proliferous shoots producing simple leaves; sandy alluvial bottomland of Three Creek, Adams Grove, no. 14,376. Greensville County: wooded bottomland of Fontaine Creek, southeast of Taylor's Millpond, plants up to 7 feet high, no. 11,384, distrib. as *S. suave* Walt. See p. 368.

Sium floridanum, not recognized when Blake made the comparison, may be *S. suave* Walt. Whether it is a distinct species or a southern variety of the transcontinental northern as well as

southern plant which now passes as *S. suave* (*S. cicutaefolium*) is not wholly clear. The common northern and wide-ranging plant, which we call *S. suave*, has (except in the submersed forma *Carsonii* (Durand) Fassett and in the wholly atypical estuarine forma *fasciculatum* Fassett) the erect or ascending stem strongly corrugated; *S. floridanum* has the usually slender and more flexuous stem terete, in drying only slightly ribbed. In *S. suave* the stem branches near the summit, usually above the middle; the corrugate-angulate branches are strongly ascending; and the principal cauline leaves (below the branching) are strongly ascending, with 5–17 firm leaflets 4–15 cm. long. In *S. floridanum* the stem branches usually well below the middle, the terete branches are spreading-ascending to nearly horizontal; and the larger divergent to horizontally spreading leaves have 3–11 membranaceous leaflets 2–9 cm. long. In *S. suave* the largest (leading) umbel of each plant is 4–11 cm. broad, with angulate peduncle and 10–25 definitely angled (when dry) rays; in *S. floridanum* the more open fully developed umbels are 1–7 cm. broad, on filiform peduncles and with 7–15 filiform rays. In *S. suave* the angled pedicels of the umbellules are stiffly ascending; in *S. floridanum* the filiform pedicels are more curving or arching and prolonged. In flower and fruit the two are similar, but the petals of *S. floridanum* are narrower and the filaments and styles longer than in *S. suave*. As stated, when we have fuller material *S. floridanum* may prove to be a geographic variety, rather than a true species. The contrasts are here stated, that others may watch for this southern plant. As stated also, Walter could have had either as the basis of his *S. suave*.

Sium suave, forma *Carsonii*, the submersed and weak state of the wide-ranging transcontinental plant, has filmy foliage and small mostly infertile umbels. It might seem to some to include *S. floridanum;* but it is clearly demonstrated to be merely an ecological phase of *S. suave* (*cicutaefolium*). Its ascending petioles, its angulate-corrugated umbel-rays (when dry), its short and stiff pedicels, broadly rounded petals, short filaments and short style clearly show it to be *S. suave*.

Pyrola rotundifolia L., var. americana (Sweet) Fern. Brunswick County: wooded bluff along Rattlesnake Creek, west of Triplett, *Fernald & Lewis*, no. 14,538, healthy colony,

never flowering. Station at remarkably low altitude for southern Virginia. See p. 377.

*Vaccinium stamineum L., var. interius (Ashe) Palmer & Steyermark (*Polycodium interius* Ashe). Hanover County: dry sterile woods near Polegreen, no. 13,417 (fruit blue with a bloom). James City County: woods north of Jamestown Road, about 1 mile from Willamsburg, *J. T. Baldwin, Jr.* no. 206.

Var. *interius*, as its name implies, is a characteristic shrub of the Interior. The material (except for these sheets from eastern Virginia) in the Gray Herbarium is from West Virginia, Kentucky, Missouri, Arkansas, northern Louisiana, Kansas and Oklahoma. It is of course questionable if it is a true geographic variety, the characters ordinarily used in this series (genus *Polycodium*) being very plastic or fickle. In eastern Virginia we get three of these: typical *V. stamineum* with the young branchlets pilose, the mature leaves somewhat so on the lower surface or the lateral veins, a very common plant; var. *interius* with young branchlets pilose but the leaves glabrous except along the midrib beneath; and the common var. *neglectum* (Small) Deam, with young twigs and leaves both quite glabrous. *V. caesium* Greene, a low shrub (commonly only 2–5 dm. high) of sandhills and pine barrens closely approaches the state in North Carolina, and may be watched for with confidence. Its small and broad leaves (1.5–5 cm. long) and the very large and rounded bracts (1–2 cm. broad) greatly exceeding the subtended pedicels well mark it. The group is by no means properly understood, and the varieties (species of Greene, Ashe and Small) may prove to be minor forms without good geographic ranges.

*V. virgatum Ait. Southampton County: dry white sand in oak and pine woods and clearings bordering Assamoosick Swamp, south of Sebrell, no. 10,374, as *V. Elliottii* Chapm.—shrubs 2 m. high. Originally, on account of its stature, placed in *V. Elliottii* but differing clearly from that species, which has the leaves lustrous and full green on both surfaces, membranaceous and without reddish glands and gradually rounded to base, by its firmer leaves subcuneate at base, reddish glandular hairs mixed with the pilosity of the lower surface, and the very stiff and compact branching. It fairly matches more southern material identified by Gray and later by Camp as true southern *V. virgatum*.

*V. vacillans Torr., var. crinitum Fern. Surry County: dry thicket 1 mile north of Surry Courthouse, no. 10,773, narrow-leaved extreme.

Photo. B. G. Schubert.

PHYSOSTEGIA DENTICULATA: FIG. 1, plant, × ⅖
P. INTERMEDIA: FIG. 2, plant, × ½; FIG. 3, leaf-margin, × 2

Photo. B. G. Schubert.

PRASIUM? PURPUREUM Walt.: FIG. 1, leaf, × 1, from tracing by *S. F. Blake*
PHYSOSTEGIA ANGUSTIFOLIA: FIGS. 2–4, *Drummond*, no. 251, × 5/9; FIG. 5, leaf of 251, × 2; FIG. 6, TYPE of species, × 5/12; FIG. 7, portion of leaf, × 2, from TYPE

Camp has renamed *Vaccinium vacillans* as originally and beautifully described by Torrey, Fl. N. Y. **1:** 444 (1843). In its place he publishes the very appropriate *V. Torreyanum* Camp in Am. Midl. Nat. xxiii. 177 (1940) = "*Vaccinium vacillans* Torrey, Fl. N. Y. **1:** 444. 1843 (non exemp. in Mus. Brit.)" and to *V. pallidum* Ait. he refers "*Vaccinium vacillans* Kalm, apud Torrey, Fl. N. Y. **1:** 444. 1843 (typ. in Mus. Brit. est)."

Torrey, unfortunately, gave to the familiar shrub so clearly described from New York state an old herbarium-name, *V. vacillans* "*Kalm, mss. in Herb. Banks*". The latter is worse than a *nomen nudum*. It had never been published even as a *nomen* and, surely, Torrey had not seen it in Banks's herbarium, since he did not go abroad. At best he had hearsay knowledge of it. I am, therefore, unable to see that a mere herbarium-name, given by Kalm to something which Torrey had not seen and which, according to Camp's note, he wholly misunderstood, takes precedence over the material from "the vicinity of New York" which Torrey so fully and accurately described. I retain the name *V. vacillans* as of Torrey. Had the name *V. vacillans* been accompanied by a description of Kalm's material or had it been previously published, it would stand for that element. Since Torrey, who first took up the name, described only the New York element, which Kalm did not have, the name is typified by Torrey's material, the only material described.

Styrax americana Lam. To the relatively few stations in Virginia add one in Sussex County: upper border of sandy beach, Airfield Millpond, southwest of Wakefield, no. 14,383. See p. 372.

*Cynoctonum sessilifolium (Walt.) J. F. Gmel. Brunswick County: wet level opening in woods, 1½ miles southeast of Triplett, August 24, 1942, *J. B. Lewis*. See pp. 374 and 376.

Polypremum procumbens L. It is so often stated that *Polypremum* is an annual ("much branched small annual"—Gray, Man.; "annual diffuse herb"—Small, Man.) that the correct description of Gray, Synopt. Fl., should be emphasized: "much branched from an annual (sometimes almost ligneous) root." In sandy clearings of Brunswick County the mature plants, late in the autumn, send out vigorous and crowded new basal offshoots, much as in *Lechea* (see *Fernald & Lewis*, no. 14,492).

Amsonia Tabernaemontana Walt. Local range extended to Brunswick County: rich wooded slope below Western Bridge,

Meherrin River, south of Edgerton, *Fernald & Lewis*, no. 14,491. See p. 380.

*Asclepias lanceolata Walt., var. paupercula (Michx.) Fern., forma **flaviflora,** floribus flavis. Norfolk County: fresh reed-marsh and swale along Northwest River near Northwest, June 30, 1942, *Fernald & Long*, no. 14,390—a single plant associated with the rather abundant typical var. *paupercula* in which the hoods are deep orange to scarlet. Type in Herb. Gray. See p. 368.

*Acerates viridiflora (Raf.) Eaton, var. lanceolata (Ives) Gray. Prince George County: argillaceous field north of Fort Hell, south of Petersburg, very scarce, no. 12,778. Sussex County: open thickets and clearings near Nottoway River at Readjuster Bridge, south of Peanut, no. 12,438.

Acerates viridiflora is excessively variable in foliage but all the material before me from southern New England and southern New York southward to the Carolinas, with the exception of five numbers from eastern Pennsylvania (Phil. Acad.) and the two numbers above cited, has the blunt or abruptly short-tipped leaves elliptic, oblong, oval or oblong-obovate and is, I take it, true *A. viridiflora.* Rafinesque's original description called for a "lanceolated, obtuse" leaf, "leaves lanceolated, obtuse, hirsute, umbells axillar, bending down, corniculas, without appendices. I have found it in several parts of Maryland and Pennsylvania, mostly in fields." In view of the oblong, elliptic or oblong-obovate outline of the obtuse leaves in the plant of Pennsylvania and Maryland, it is assumed that Rafinesque's "lanceolated" was used with poetic license.

In the representation in the Gray Herbarium there is no material of this obtuse-leaved plant from the north-central states. It occurs in North Carolina (Small implies Florida), Louisiana, Texas and New Mexico, northward in the Mississippi drainage to Kentucky and Kansas. From southern Ontario to Manitoba and Wyoming the usual plant has lanceolate to narrowly ovate leaves tapering from near the base to acuminate or prolonged acute tips. This is var. *lanceolata* (Ives) Gray, occurring from southern Ontario, Manitoba and Wyoming southward to Louisiana, Texas and New Mexico, in the South mingling with the obtuse-leaved plant. I am quite unable to separate the two numbers from Virginia and some from southeastern Pennsylvania from characteristic var. *lanceolata* of the Interior. In the East

they look like mere leaf-variations of one plant. In view of the very different broad ranges of the two, however, I am making this note, especially with the hope that the plants will be carefully checked elsewhere in the East.

Phlox nivalis Lodd. (*P. Hentzii* Nutt.) An extensive station in Greensville County: dry sandy woods along Fontaine Creek, Round Hill Church, *Fernald & Lewis*, no. 14,543. See p. 383.

P. carolina L., var. triflora (Michx.) Wherry. Another station in Dinwiddie County: low open pineland, thickets and clearings just east of McKenney, no 14,393. See p. 365.

Nemophila microcalyx (Nutt.) Fisch. & Mey. This vernal annual, characteristic along the James, is also in Greensville County: rich woods along Meherrin River, below Emporia, *Fernald & Lewis*, no. 14,542, growing with the abundant *Phacelia dubia* and very luxuriant (up to 4.5 dm. high). See p. 383.

Hydrolea quadrivalvis Walt. Range extended inland to Brunswick County: swampy pond-hole in woods, Rattlesnake Creek, west of Triplett, *Fernald & Lewis*, no. 14,493. See p. 377.

Myosotis verna Nutt. Local range extended. James City County: rich woods and slopes by James River, Grove Landing, southeast of Grove, Fernald, Long & Abbe, no. 14,227. Sussex County: fallow field along Nottoway River at Readjuster Bridge, south of Peanut, *Fernald, Long & Abbe*, no. 14,228.

Scutellaria serrata Andr. Brunswick County: rich wooded slope near Western Bridge, Meherrin River, south of Edgerton, *Fernald & Lewis*, no. 14,494. See p. 380. Epling, in his American Species of Scutellaria, Univ. Cal. Pub. Bot. xx. no. 1, 85 (1942) cites no Virginia specimens from the southern counties east of the Blue Ridge.

*Physostegia **aboriginorum,** sp. nov. (tab. 783), planta robusta 10.5–12 dm. alta basi valde surculoso; caule glabro ad basin 0.8–1 cm. diametro; foliis firmis sessilibus vel imis late subpetiolatis oblongis obtusis vel subacutis undulato-sinuatis, primariis 8–11 cm. longis 1.7–2.5 cm. latis; inflorescentia paniculata, ramibus lateralibus prolongatis arcuato-adscendentibus; spicis subdensis 0.4–2 dm. longis, calycibus fructiferis imbricatis, rhachi puberula; calycibus breviter campanulatis puberulis, tubo maturo 5–6 mm. longo, dentibus deltoideis; corollis purpureis 2–2.5 cm. longis fauce ampliato 8–10 mm. diametro; filamentis ad apicem villosis.—Norfolk County, Virginia: swale at margin of Indian Creek (whence the specific name), northeast of Northwest, June 30, 1942, *Fernald & Long*, no. 14,397 (type in Herb. Gray.; isotype in Herb. Phil. Acad.). See p. 368.

Physostegia aboriginorum differs strikingly from the more fre-

quent species of southeastern Virginia (of the Blackwater and the Nottoway drainage-systems) in its broader-oblong, merely undulate-margined, firm sessile leaves, the lower ones narrowed merely to dilated bases, the upper ones but slightly reduced in size; the panicled spikes densely flowered, with imbricated pairs of fruiting calices; the corolla more ampliate; the filaments copiously pilose to summit. *P. denticulata* (Ait.) Britton (our PLATE 784, FIG. 1), common in the alluvium of the Nottoway or the Blackwater and their tributaries in Southampton, Isle of Wight and Nansemond Counties, has the leaves thin and membranaceous, the lower 4 to 6 pairs oblanceolate or oblong and on long slender petioles, the middle and upper ones sessile and long-attenuate at tip, the uppermost very small. Its usually solitary, slenderly elongate spike is very interrupted, the pairs of flowers and fruiting calices remote; the corolla more slender, the filaments glabrous or only sparsely pilose at tip.

From *Physostegia leptophylla* Small the Norfolk County plant differs in its much larger leaves in more scattered and more sessile pairs, with merely undulate margins, and in its more slender corolla, *P. leptophylla* having the many (up to 16) pairs of more prominently dentate leaves mostly narrowed to base and the greatly distended corolla with throat 1.5 cm. broad at summit. From *P. veroniciformis* Small *P. aboriginorum* differs in much greater size, the leaves not fiddle-shaped, the calyx-lobes short and deltoid, instead of elongate and lanceolate, the corolla larger, and the long, as well as the short, filaments hairy.

This segregation of species of the Northwest River and its tributary, Great Dismal Swamp, and the North Landing River drainage, with small tributaries interlocking with those of the Northwest River, both emptying into the head of Currituck Sound, is very real. The Blackwater and Nottoway merge at the State Line to form the Chowan, which, a few miles farther south receives the Meherrin and then empties into Albemarle Sound. On the bottomlands or wooded slopes of the Blackwater, Nottoway or Meherrin on the Coastal Plain of Virginia hundreds of species occur which we do not know from the bottoms, swamps and marshes of the more eastern drainage systems. Conversely the Northwest and North Landing drainage (or that of Back Bay slightly to the east) have scores (many

more yet to be discovered) of plants which we do not know from the Blackwater, the Nottoway or the Meherrin drainage (*Pinus serotina, Limnobium Spongia, Arundinaria gigantea, Andropogon virginicus* var. *glaucopsis, Scleria flaccida, Cladium jamaicense, Wisteria frutescens, Ilex vomitoria, I. coriacea, Stewartia Malachodendron, Ludwigia pilosa, L. alata, Asclepias lanceolata* var. *paupercula, Lobelia elongata, Eupatorium recurvans, E. cuneifolium, Aster Elliottii*, etc.). *Physostegia aboriginorum* is the latest addition to this series.

I am using the name *Physostegia denticulata* in its traditional sense. Originally published as *Dracocephalum denticulatum* by Aiton, Hort. Kew. ii. 317 (1789) from Carolina material, its diagnosis was good, though very brief: "D. floribus spicatis remotis, foliis obovato-lanceolatis superne denticulatis". Such a plant abounds, as stated, on the Coastal Plain bottomlands of the Blackwater and the Nottoway, thence south to Florida, represented in the Gray Herbarium by material from five counties of North Carolina: Hertford, on the Chowan River, and Perquimans, draining into Albemarle Sound; thence south to the region of Wilmington, and from Georgetown County, South Carolina. The general geographic source of Aiton's material is unequivocal.

In Rhodora, xvii. 134 (1915) Blake, publishing the combination *Physostegia purpurea* (Walt.) Blake, based on *Prasium? purpureum* Walt. Fl. Carol. 166 (1788), identified it with *P. denticulatum*. Walter's diagnosis was as follows: "foliis oppositis sessilibus lanceolatis dentatis, floribus purpureis, spicis distichis terminalibus"; and the very sketchy sketch (our plate 785, fig. 1) made by Blake of the type of *Prasium? purpureum* is difficult to match in any material usually placed in *Physostegia denticulata*. Blake's description (mss. in Gray Herb.) of the specimen says "leaves . . . 3 mm. wide . . . Corolla would be just 2 cm. long if straightened out . . . It agrees very well with Drummond 251, *e. g.* in Brit. Mus." Now it so happens that Drummond's no. 251 from New Orleans (our plate 785, figs. 2–5) has elongate-linear leaves very strongly suggesting Blake's sketch of the much crumpled Walter type, but it has finely sharp-serrate margins (fig. 5) and is a quite characteristic specimen of a wide-ranging species (our plate 785,

FIGS. 6 and 7) which occurs from Tennessee to Illinois and Arkansas, south to Mississippi, Louisiana and Texas, the plants variously misidentified as *P. denticulata*, *P. virginiana* (L.) Benth. ("very slender form") and *P. speciosa* Sweet. Furthermore, a habitally quite similar species, *P. intermedia* (Nutt.) Engelm. & Gray (our PLATE 784, FIGS. 2 and 3), with slender and interrupted spike and with leaves narrowly lanceolate to linear but with flowers relatively small, extends eastward into Kentucky and Alabama. This small-flowered species has the leaves dentate, as described by Walter for *Prasium? purpureum*, not acutely serrate as in *Drummond*, no. 251; but, so far as we know, neither of these sessile- and narrow-leaved species is east of the mountains. With no such plant as indicated by Blake's sketch (PLATE 785, FIG. 1) now known in Walter's territory, it is unsafe to assert with confidence just what his *Prasium? purpureum* is. Until Walter's type can be rechecked with Drummond's no. 251 (with linear, sharp-toothed leaves and slender, interrupted spikes) clearly in mind there must remain some doubt regarding its identity with *Physostegia denticulata*. Until his type can be reexamined and closely compared with a series including all known species of the Carolinas, as well as *Drummond*, no. 251 and *Physostegia intermedia*, it is safest to let the name rest, as it did until Blake took it up, as still of doubtful significance.

I am, therefore, at the risk of possibly publishing a species already inadequately described, proposing

P. **angustifolia,** sp. nov. (TAB. 785, FIG. 2–7), planta erecta caule glabro 3–10 dm. alto; foliis rigidis griseis vel pallidis linearibus vel anguste lanceolatis sessilibus numerosis (16–22 jugis), imis obtusis vel subacutis, mediis attenuatis valde angusteque adpresso-serratis 4–10 cm. longis 3–10 mm. latis, foliis supernis valde reductis; spicis solitariis vel paniculatis elongatis ad 3.5 dm. longis floribus distantibus, rhachi puberulo; calycibus campanulatis 6–10 mm. longis pruinoso-puberulis glandulosisque dentibus deltoideis acuminatis; corollis purpureis vel albescentibus 2.5–3 cm. longis.—TENNESSEE: thickets along fence, Lavergne, Rutherford County, August 12, 1922, *Svenson*, no. 242. MISSISSIPPI: roadside bank near Egypt, Chickasaw County, May 18, 1933, *C. A. & Una F. Weatherby*, no. 6318, TYPE in Herb. Gray. ILLINOIS: Arlington Heights, Cook County, August 25, 1934, *Benke*, no. 5680; prairie, South Chicago, September 15, 1910, *Lansing*, no. 2803; Champaign, September 11, 1909, *Pease*, no. 12,403; LaSalle County, *Huett;* Sugar Creek Prairie, Richland

County, September 5, 1914, *Robert Ridgway.* ARKANSAS: moist roadside and ditch-bank, Fayetteville, June 13, 1938, *Fassett & Nielsen,* no. 19,829; low ground, northwestern Arkansas, June, *F. L. Harvey,* no. 116. LOUISIANA: Covington, May and June, *Hale;* New Orleans, 1832, *Drummond,* no. 251. TEXAS: de Bejar à Austin, Avril, 1828, *Berlandier,* no. 466; Amelia, Jefferson County, October 5, 1934, *Cory,* no. 11,108; Kerrville, Kerr County, June 25, 1894, *Heller,* no. 1906; 8 miles south of Bandera, Bandera County, June 5, 1933, *Cory,* no. 6607.

Most of the material (including many specimens not cited) has been distributed as *Physostegia virginiana* (L.) Benth., but that, as shown by a beautiful photograph of the type before me, is the common northeastern plant with relatively thin, lanceolate, often copiously and saliently serrate leaves mostly 1–2.5 cm. wide, the uppermost much reduced, the flowers in relatively short and crowded spikes (in fruit with imbricated calices and rarely 2 dm. long), the corolla 2–3 (in the type 2.4) cm. long. It has also been called *P. virginiana* var. *speciosa* (Sweet) Gray, but that is a variation of *P. virginiana* with broader and often more prominently serrate leaves, the larger blades 2–4 cm. wide and less reduced in size toward the summit of the stem. Sweet's original plate shows the corolla 2.5 cm. long.

Relatively small plants of *Physostegia virginiana* from the lower Susquehanna in southeastern Pennsylvania have sometimes been called *P. denticulata* because their leaves have the marginal teeth few and short. Similar forms, with low stature, small leaves and reduction of teeth, abound about Lake Champlain and in the vicinity of Montreal on the St. Lawrence. Others from the same regions and of similar proportions have well developed sharp teeth. They seem to be a reduced state of *P. virginiana,* somewhat atypical but without constant enough characters to merit specific recognition. The designation of the individuals of this small extreme of tidal shores of the St. Lawrence as a distinct species, *P. granulosa* Fassett in RHODORA, xli. 377 (1939), our PLATE 786, FIGS. 1 and 2, because it is stoloniferous and because its calyx is more glandular-puberulent than in some *P. virginiana,* overlooks the fact that carefully collected *P. virginiana* has stolons. Witness specimens of *Fernald & Long,* no. 14,465 from Hampden, Maine, of *Fassett,* no. 14,341 (our PLATE 786, FIGS. 3 and 4) from Bingham, Maine (toward 50 miles up-

river beyond the limit of tide and with leaves as small as and with fewer teeth than in isotypes of *P. granulosa*—in no. 14,341 some leaves with as few as 2–5 low teeth on each side, the type of *P. granulosa* described as with 4–8 but the isotypes in the Gray Herbarium showing 5–9 pairs of teeth), of the Faxons and others from Lake Champlain (PLATE 786, FIG. 5), of Eames from Trumbull, Connecticut, or of any other botanist who takes pains carefully to collect the stolons. The small extreme with small leaves having few and low teeth and the pubescence of the calyx short and glandular is noteworthy but scarcely a good species. I am calling it

P. VIRGINIANA (L.) Benth., var. **granulosa** (Fassett), stat. nov. *P. granulosa* Fassett in RHODORA, xli. 377 (1939). PLATE 786.

On the St. Lawrence var. *granulosa* is on areas covered by high tide; the lower part, at least, of its range on the Susquehanna is tidal shore; on Lake Champlain, where the variety abounds, and on the middle and upper Kennebec it is in areas which have had no extensive tides since the Champlain Subsidence, at which time a fresh arm of the sea entered Lake Champlain and a tongue extended well up the Kennebec. Can it be that the variety originated on Lake Champlain and the upper Kennebec at that period?

PLATE 783. PHYSOSTEGIA ABORIGINORUM Fernald: FIG. 1, TYPE, × ½; FIG. 2, flower, × 2; FIG. 3, mature calices and rachis, × 5.

PLATE 784. P. DENTICULATA (Ait.) Britton: FIG. 1, characteristic plant, × ⅖, from Monroe Bridge, Nottoway River, Southampton County, Virginia, *Fernald & Long*, no. 13,122. P. INTERMEDIA (Nutt.) Engelm. & Gray: FIG. 2, plant, × ½, from Lake City, Craighead County, Arkansas, *Demaree*, no. 5089; FIG. 3, leaf-margin, × 2, from no. 5089.

PLATE 785. PHYSOSTEGIA: FIG. 1, tracing of leaf of type of *Prasium? purpureum* Walt., by Blake. PHYSOSTEGIA ANGUSTIFOLIA Fern.: FIGS. 2–5, *Drummond*, no. 251, × 5/9, said by Blake to match Walter's type of *Prasium? purpureum* (FIG. 1), which is also said to be *Physostegia denticulata* (see PL. 784, FIG. 1); FIG. 5, leaf of no. 251, × 2; FIG. 6, TYPE of PHYSOSTEGIA ANGUSTIFOLIA, × 5/12; FIG. 7, portion of leaf, × 2.

PLATE 786. P. VIRGINIANA (L.) Benth., var. GRANULOSA (Fassett) Fernald: FIGS. 1 (× ½) and 2 (× 2), of isotype of *P. granulosa* Fassett, from Cap Rouge, Quebec, *Victorin*, no. 28,178; FIGS. 3 (× ½) and 4 (× 2) from Kennebec River, Bingham, Maine, *Fassett*, no. 14,341; FIG. 5, × ½, from Lake Champlain, South Hero, Vermont, *Hunnewell*, no. 13,902.

STACHYS CLINGMANII Small. SURRY COUNTY: rich alluvial woods and thickets back of sand-beach of James River, below Sunken Meadow Beach, no. 8446; thicket back of sand-beach of Cobham Bay, James River, northwest of Chippokes, no. 12,788.

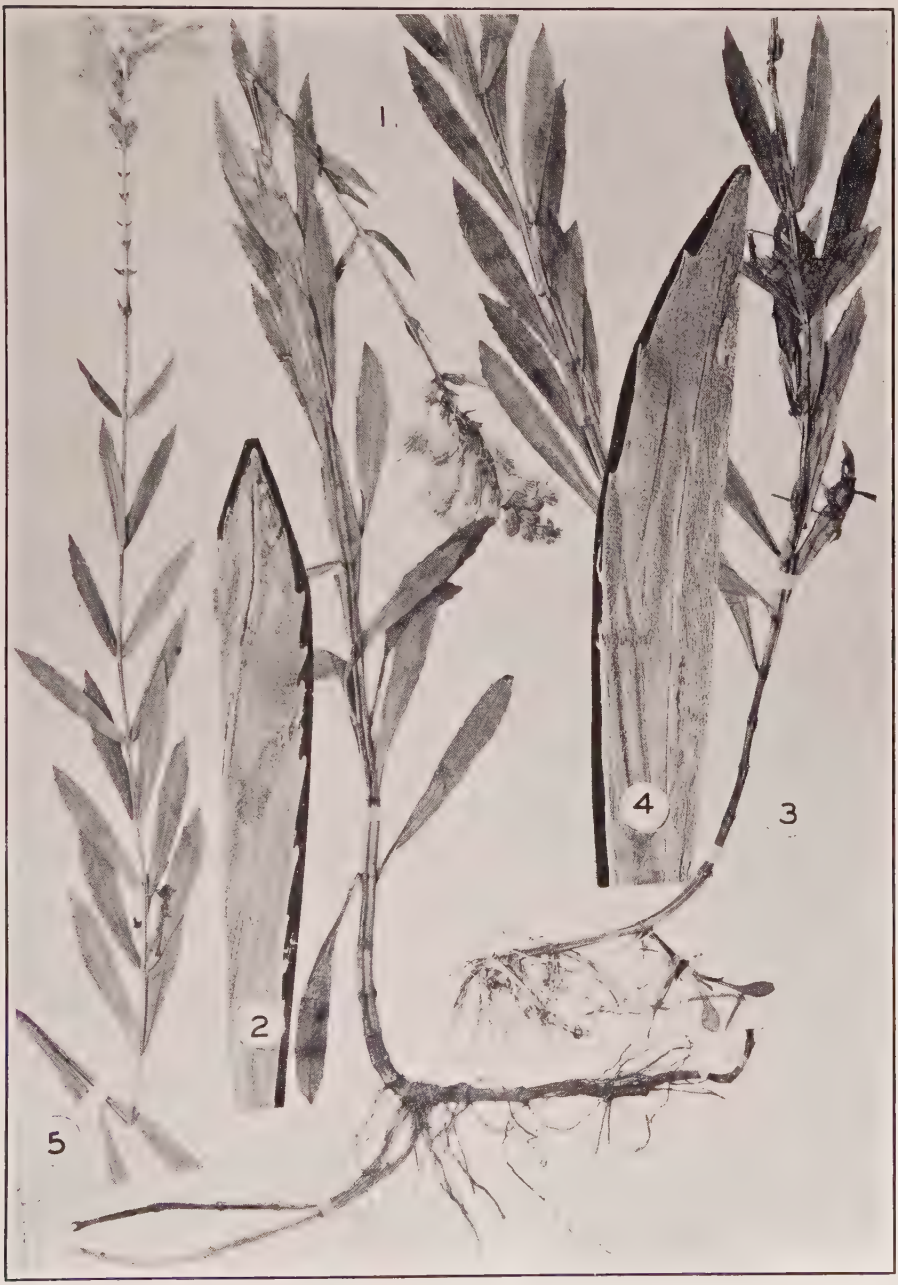


Photo. B. G. Schubert.

PHYSOSTEGIA VIRGINIANA, var. GRANULOSA: FIG. 1, ISOTYPE, × ½; FIG. 2, portion of leaf of ISOTYPE, × 2; FIG. 3, plants, × ½, from upper Kennebec River, Maine; FIG. 4, leaf, × 2, from the last; FIG. 5, plant, × ½, from Lake Champlain

Photo. B. G. Schubert.

STACHYS TENUIFOLIA: FIG. 1, plant, × ½; FIG. 2, surface of stem, × 10; FIG. 3, lower surface of leaf, × 10; FIG. 4, bracts and flower, × 4

Both numbers have been erroneously reported in previous records as *Stachys Nuttallii* Shuttlew. The latter species of western North Carolina and eastern Tennessee has the sides of the stem minutely glandular-puberulent, the sessile or subsessile leaves glabrous beneath, the glandular and short-pilose calyx with broadly deltoid teeth. Our plant, also of the mountains, thence westward to Illinois, is the *S. Nuttallii* sensu Robinson & Fernald in Gray, Man. ed. 7. Its stems are glabrous on the sides, the membranous leaves slender-petioled and copiously hispid on the veins and veinlets beneath, the calyx glandular and minutely pilose, with narrow teeth long-subulate at tip. On the lower James it is as notable an isolation from the Appalachian Upland as if it were really *S. Nuttallii*.

*S. TENUIFOLIA Willd. CHARLES CITY COUNTY: alluvial woods along James River, Harrison Point, no. 9133. SOUTHAMPTON COUNTY; open sandy alluvial bank of Nottoway River, below Cypress Bridge, and wooded bottomland, Cypress Bridge, nos. 6370 and 8447. GREENSVILLE COUNTY: wooded alluvial bottomland of Meherrin River, near Haley's Bridge, no. 9418. See PLATE and MAP 1.

Apparently typical *Stachys tenuifolia* is not definitely recorded as Virginian. In his *Preliminary Revision of American Stachys* in Fedde, Repert. Sp. Nov. Beih. lxxx. 68 (1934), Epling gives the range "from Western New York and Southeastern Pennsylvania westward to Michigan and Minnesota, and Southwestward through Tennessee and Alabama to Louisiana and Texas". He could have extended it southeastward into Georgia; at least a characteristic specimen from northern Georgia, coll. *Chas. Wright*, correctly identified by Asa Gray and validated by Epling in 1931, is in the Gray Herbarium. True *S. tenuifolia* is, obviously, chiefly a plant of the Interior; its occurrence on the bottomlands of southeastern Virginia is another instance of a now familiar isolation, as is material from river-swamp of Santee River in Charleston County, South Carolina, *Godfrey & Tryon*, no. 728. Epling's only suggestion that *S. tenuifolia* occurs in Virginia is his note that "Specimens collected . . . by Killip (no. 6286) near Great Falls, Virginia, show an apparent intermixture with *S. hispida* chiefly in hairiness of the calyces and the more subulate calyx teeth". Such transitions to *S. hispida* are so frequent that I cannot feel that the two are distinct

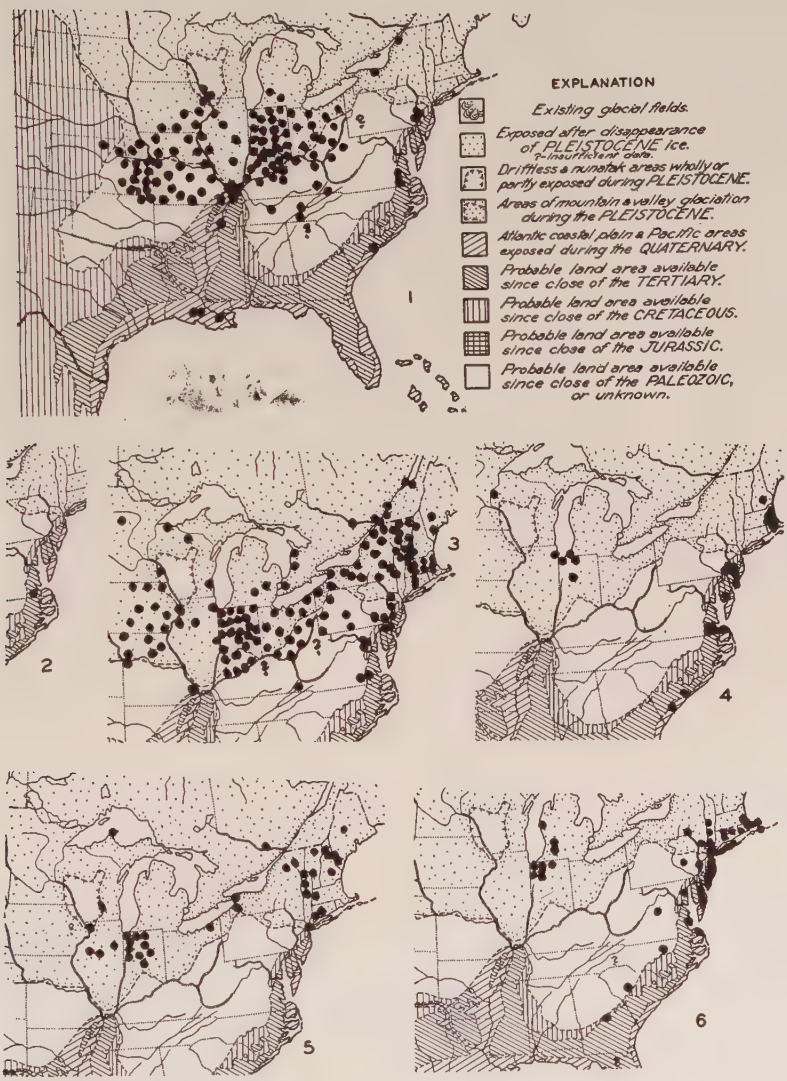
species, but are rather well pronounced geographic varieties. The following number from southeastern Virginia combines too intimately the characters of typical *S. tenuifolia* and those of typical *S. hispida*: Southampton County: bushy swales and borders of swampy woods near Blackwater River, Cobb's Wharf, no. 10,407. As I understand *S. tenuifolia* and *S. hispida* they are the two extremes of a rather polymorphous species, characterized by having the sides of the stem glabrous, the leaves with glabrous lower surfaces or with hispidity along the veins and veinlets but not on the intermediate tissue, and in the calyx being glabrous, or bristly only on the angles, its lance-attenuate teeth soon outwardly curving. As a polymorphous relatively southern species it is distinguished from the more northern (circumboreal) *S. palustris* L., in which the surfaces of the stem are pubescent, the leaves pilose to puberulent beneath, and the surfaces of the calyx pilose. My interpretation of *S. tenuifolia* is shown in the following brief synopsis.

a. Bracts at base of glomerules of spike not ciliate; calyx glabrous throughout; leaves glabrous on both faces, the principal ones with slender petioles 0.5–3 cm. long.
Leaf-blades lanceolate to ovate-oblong or narrowly ovate, one fifth to three fifths as broad as long, the principal ones 4–10 cm. long and 1.2–6 cm. broad; spike stiff ..... *S. tenuifolia*, typical.
Leaf-blades narrowly oblong, about one sixth as broad as long; the median ones 1–1.5 dm. long and 1.6–2 cm. broad; spike flexuous ..... Var. *perlonga*.

a. Bracts bristly-ciliate; calyx often bristly on the angles; leaves often hispid on veins beneath, sessile, or the lower ones short-petioled.
Principal leaves broadly oblong to narrowly ovate, one third to three fifths as broad as long, 5–15 cm. long, 2–6 cm. broad, glabrous to sparsely strigose above. Var. *platyphylla*.
Principal leaves narrowly lanceolate to narrowly lance-oblong, one sixth to one fourth as broad as long, 3–10 cm. long, 0.8–2.4 cm. broad, mostly strigose above . . . Var. *hispida*.

S. tenuifolia Willd. Sp. Pl. iii. 100 (1800). *S. glabra* Riddell, Suppl. Cat. Ohio Pl. 16 (1836). *S. aspera*, var. *glabra* Gray, Syn. Fl. N. Am. ii[1]. 387 (1878). *S. cincinnatensis* Ktze. Rev. Gen. ii. 531 (1891).—Rich bottomlands, shores, low woods and meadows, New York to Minnesota, south to southeastern South Carolina, northern Georgia, Tennessee, northern Louisiana and eastern Texas. Plate 787 and map 1.

*Var. **perlonga**, var. nov. (tab. 788, fig. 1 et 2), var. typicae simillima; foliis anguste oblongis, mediis 1–1.5 dm. longis 1.6–2 cm. latis; spica flexuosa. Virginia: bottomland woods


EXPLANATION
Existing glacial fields.
Exposed after disappearance of PLEISTOCENE ice.
?=insufficient data.
Driftless & nunatak areas wholly or partly exposed during PLEISTOCENE.
Areas of mountain & valley glaciation during the PLEISTOCENE.
Atlantic coastal plain & Pacific areas exposed during the QUATERNARY.
Probable land area available since close of the TERTIARY.
Probable land area available since close of the CRETACEOUS.
Probable land area available since close of the JURASSIC.
Probable land area available since close of the PALEOZOIC, or unknown.
1
2
3
4
5
6

Range of (1) STACHYS TENUIFOLIA; (2) S. TENUIFOLIA, var. PERLONGA; (3) S. TENUIFOLIA, var. PLATYPHYLLA; (4) S. TENUIFOLIA, var. HISPIDA; (5) S. PALUSTRIS, var. HOMOTRICHA (*S. ambigua* sensu Epling, not Sm.); (6) S. HYSSOPIFOLIA

along Meherrin River northeast of Gaskins, Greensville County, June 13, 1941 (foliage), August 8, 1941 (flowers and young fruit), nos. 13,128 and 13,435 (TYPE in Herb. Gray.; ISOTYPE in Herb. Phil. Acad.). MAP 2.

*Var. **platyphylla,** var. nov. (TAB. 789), caule ad angulos retrorse setoso; foliis primariis late oblongis vel anguste ovatis 5–15 cm. longis 2–6 cm. latis supra glabris vel sparse strigosis subtus ad venas hispidis vel glabris.—Low woods, rich shores and meadows, southern Quebec to Minnesota, south to eastern South Carolina, western North Carolina, Indiana and Illinois. The following, selected from a large series, are characteristic. QUEBEC: sur les rivages du Fleuve St.-Laurent, St.-Francois, Ile d'Orleans, 13 juillet 1935, *Victorin et al.*, no. 43,661; rivages Fl. St.-Laurent, Berthier en Bas, 3 août 1925, *Rousseau*, no. 21,610; Valleyfield, Co. Beauharnois, 6 septembre 1930, *Victorin, & Rolland*, no. 33,953; rivage, Ile Plate, Longueuil, 28 août 1928, *Victorin*, no. 28,272. MAINE: East Livermore, July 5, 1909, *Kate Furbish;* by small pond, Portland, June 20, 1909, *Fernald*, no. 2158. NEW HAMPSHIRE: bank of Connecticut River, Stratford, September 3, 1909, *Pease*, no. 17,705. VERMONT: pebbly lake-shore, Highgate Springs, July 19, 1938, *Pease*, no. 26,746; sandy shore of Connecticut River, Norwich, July 11, 1910, *E. F. Williams* (TYPE in Herb. Gray.); sandy bank, Burlington, July 8, 1914, *C. H. Knowlton;* pebbly shore, Brattleboro, 1894, *Grout.* MASSACHUSETTS: Sudbury, July 19, 1886, *W. Deane;* bank of Neponset River between upper and lower falls, Milton, August 29, 1853, *Wm. Boott;* roadside, Wellesley, July 11, 1896, *Hunnewell;* Middleboro, August 11, 1901, *J. Murdoch, jr.;* edge of thicket, Northampton, July 23, 1932, *Hunnewell*, no. 12,496; bank of Connecticut River, Springfield, July 13, 1914, *Luman Andrews.* CONNECTICUT: bank of Connecticut River, East Windsor, July 13, 1902, *Bissell;* South Meadow, Hartford, July 7, 1908, *H. S. Clark.* NEW YORK: shores of Black Lake, Morristown, August 15, 1914, *Phelps*, no. 814; Mohawk flats east of Utica, July 18, 1900, *Haberer*, no. 709; Sylvan Beach, Oneida County, July 13, 1916, *House;* bank of Hudson River, near Cedar Hill, south of Albany, July 17, 1910, *Burnham;* wet gravelly soil, Ulysses, July 1, 1913, *E. L. Palmer*, no. 1039; moist thicket near Cold Spring, Alleghany State Park, July 30, 1926, *Alexander & House*, no. 12,783. NEW JERSEY: marsh, Rosenkraus Ferry, Delaware River, Sussex County, July 4, 1918, *E. B. Bartram;* wet ground, Kaign's Point, Camden, June 21, 1922, *Meredith;* border of tidal marsh along Delaware River, north of Penns Grove, August 9, 1935, *Fogg*, no. 9309. PENNSYLVANIA: Sellersville, July 18, 1923, *Fretz;* Greene County, July 2, 1923, *S. S. Dickey;* Presque Isle, June 29, 1922, *Dickey.* VIRGINIA: swampy woods near Nottoway River at Readjuster Bridge, south of

Photo. B. G. Schubert.

STACHYS TENUIFOLIA, var. PERLONGA: FIG. 1, ISOTYPE, × 2/5; FIG. 2, bracts and calices, × 4
S. HYSSOPIFOLIA: FIG. 3, plant, × ½; FIG. 4, bract and calyx, × 4; FIG. 5, nutlet, × 10

Photo. B. G. Schubert.

STACHYS TENUIFOLIA, var. PLATYPHYLLA: FIG. 1, TYPE, × 2/5; FIG. 2, surface of stem, × 10; FIG. 3, lower surface of leaf, × 10; FIG. 4, rachis, bracts and calices, × 4; FIG. 5, nutlet, × 10

Peanut, Sussex County, June 18, 1941, *Fernald & Long*, no. 13,129; along branch, south of Meherrin River, south of Western Bridge, Brunswick County, *J. B. Lewis*, nos. 2800 and 3538. South Carolina: Woodstock, 1833, *Gibbes* in Herb. N. Y. Bot. Gard. Ontario: Ottawa, August 8, 1894, *J. Macoun*, no. 5852; Wingham, July 24, 1894, *J. A. Morton;* Chippewa, July 5, 1858, *Wm. Boott.* Michigan: near river, Flint, July 21, 1909, *Sherff;* Agricultural College, July 25, 1896, *C. F. Wheeler.* Ohio: Troy, Geauga County, July 21, 1904, *R. J. Webb*, no. 716; Sandusky, August 1, 1894, *Moseley;* Rocky River, near Cleveland, July 13, 1896, *Greenman*, no. 1403; Painesville, July 19, 1885, *Werner*, no. 342; Sugar Grove, Fairfield County, August 6, 1892, *Werner*, no. 343; near Cincinnati, July 9, 1888, *C. G. Lloyd.* Wisconsin: Fort Wing, July 10, 1897, *L. S. Cheney*, no. 7166. Illinois: Stony Island, Cook County, June 30, 1914, *H. H. Smith*, no. 5974; damp woods, Peoria, July, 1903, *F. E. McDonald;* banks of Mississippi, near Oquawka, July 18, 1872, *Patterson.* Minnesota: Lake City, August 13, 1883, *W. H. Manning.* Map 3.

Var. **hispida** (Pursh), comb. nov. *S. hispida* Pursh, Fl. Am. Sept. ii. 407 (1814). *P. tenuifolia*, var. *aspera* sensu Fernald in Rhodora, x. 85 (1908), not *S. aspera* Michx., basonym. *S. ambigua* sensu Robinson & Fernald in Gray, Man. ed. 7: 701 (1908), not *S. ambigua* (Gray) Britton.—Meadows, swamps, low woods and shores, southern New Hampshire, eastern Massachusetts and Rhode Island, eastern New York, south to eastern South Carolina; Michigan, Wisconsin, Indiana and Illinois. The following selected from a large series, are typical. Massachusetts: tidal bank of Merrimac River, Newburyport, *Donald White*, no. 501; near Concord River, Lowell, July 14, 1880, *C. W. Swan;* riverbank, Concord, July 17, 1886, *Deane;* Prince's Pond, Needham, August 2, 1884, *T. O. Fuller;* Neponset River, Hyde Park, July 10, 1904, *A. W. Cheever;* Pine Tree Brook, Milton, July 13, 1911, *Churchill;* Dedham, July 18, 1891, *Churchill;* wet meadows, Dover, *St. John*, no. 594; open bog, Sharon, July 12, 1896, *E. F. Williams;* sandy pond-shore, Walpole, *Hunnewell*, no. 6779; Middleboro, *Richard Murdoch*, no. 933; Taunton, *F. C. Seymour*, no. 4187. Rhode Island: Providence, July, 1844, *Thurber;* Bristol, *F. S. Collins*, no. 2358; grassy bank near salt marsh, Portsmouth, July 11, 1909, *Sanford.* New York: various specimens from eastern counties intermediate between this and the preceding variety, none fully characteristic. New Jersey: along streamlet 1 mile northeast of Delanco, Burlington County, *Long*, no. 6354; fresh marshes along Wading River, New Gretna, Burlington County, *Long*, no. 10,574; rich bog along railroad, Cold Spring, Cape May County, August 29, 1922, *Fogg.* Pennsylvania: Tinicum, Delaware County, August, 1873, *Chas. Schaeffer;* meadow near Red Clay Creek,

Kennett Square, Chester County, June 28, 1924, *Mary A. Williams*. MARYLAND: King's Creek, *J. A. Holmes*, no. 98. VIRGINIA: wet argillaceous thickets and ditches, Rosemont, Princess Anne County, *Fernald & Long*, no. 5017; fresh reed-marsh and swale along Northwest River near Northwest, Norfolk County, *F. & L.*, no. 14,005; alluvial woods, along Nottoway River at Readjuster Bridge, south of Peanut, Sussex County, *F. & L.*, no. 12,459; bushy swales and borders of swampy woods near Blackwater River, Cobb's Wharf, Southampton County, *F. & L.*, no. 10,407 (transition to typical *S. tenuifolia*); alluvial woods by Fontaine Creek, west of Dahlia, Greensville County, *F. & L.*, no. 14,399; peaty and argillaceous clearing about 4 miles southeast of Emporia, *F. & L.*, nos. 8445 and 8834; bottom-land woods along Meherrin River northeast of Gaskins, Greensville County, *F. & L.*, no. 13,434. SOUTH CAROLINA: wet ditch, thicket, 13 miles east of Walterboro, Colleton County, *Wiegand & Manning*, no. 2793; border of swamp, 12 miles north of Georgetown, *Godfrey & Tryon*, no. 1067. MICHIGAN: near river, New Buffalo, *Lansing*, no. 3262. INDIANA: low place in woods, about 1 mile southeast of Woodland, St. Joseph County, *Deam*, no. 50,459; damp prairie, Roby, *Lansing*, no. 2542; Frankfort, June 27, 1886, *H. A. Young*. WISCONSIN: St. Croix Falls, July 8, 1900, *C. F. Baker*. ILLINOIS: open field, South Chicago, *H. H. Smith*, no. 5684. PLATE 790 and MAP 4. See p. 369.

Stachys hispida Pursh, typified by Epling by a Clayton specimen from Virginia (presumably in the eastern section), is, according to the description and as indicated by Epling's note on a sheet in the Gray Herbarium, this narrow-leaved extreme. Var. *hispida* has, so far as material before me shows, the broken range of many Coastal Plain types, great concentration in eastern Massachusetts and adjacent Rhode Island, absence from Connecticut and much, if not all, of New York, reappearance farther south, and with an area centering on Lake Michigan and running into Wisconsin. In Massachusetts, New Jersey, eastern Pennsylvania and eastern Virginia it tends to grow in more acid habitats than var. *platyphylla*, the latter preferring the sweeter and richer soils, as does typical *S. tenuifolia*.

The confusion of *Stachys hispida* with *S. aspera* Michaux arose through unfamiliarity with the latter. A photograph of the Michaux type now before me shows it to be, as identified by Epling, the southern plant which Gray (1878) described from Georgia, Kentucky and Illinois as *S. hyssopifolia* Michx., var.

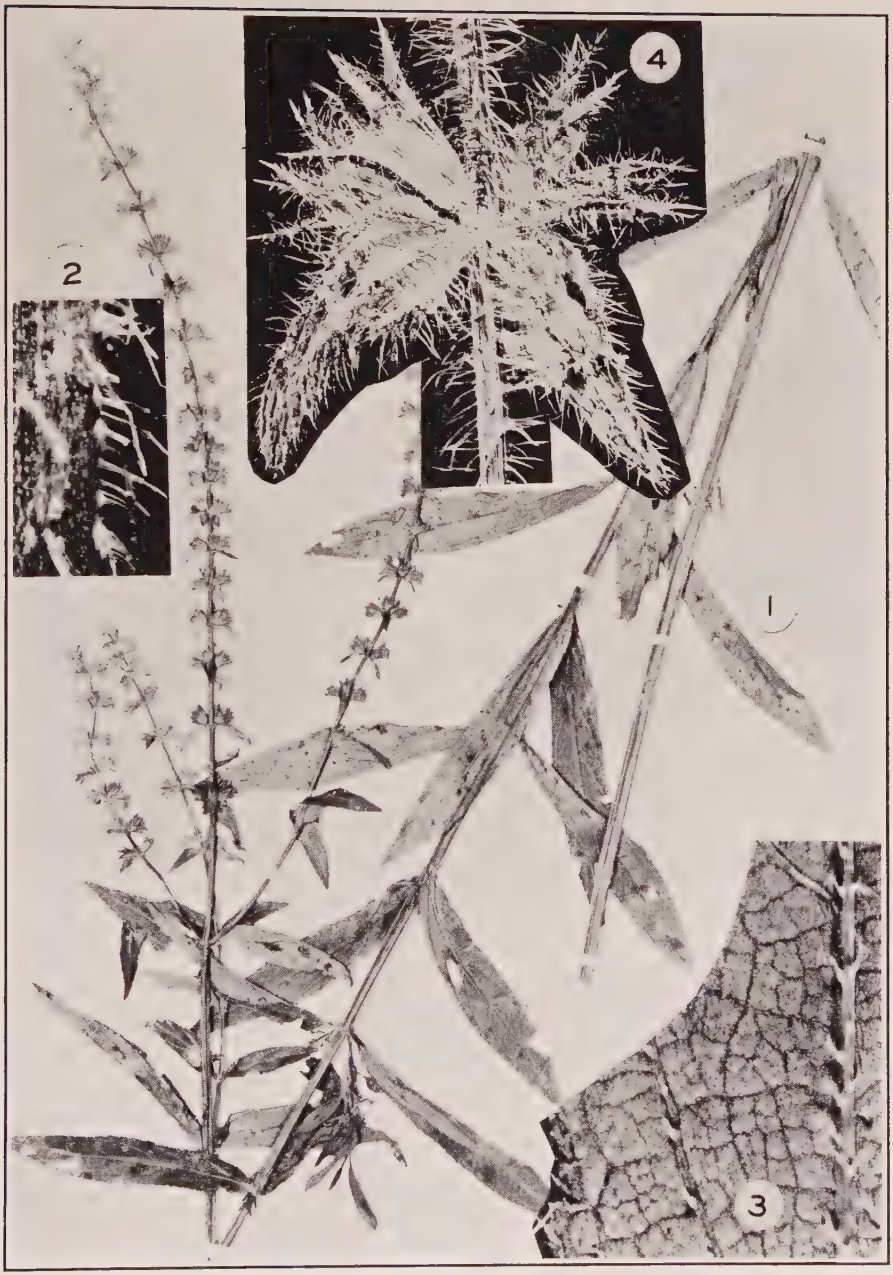


Photo. B. G. Schubert.

STACHYS TENUIFOLIA, var. HISPIDA: FIG. 1, plant, × ½; FIG. 2, portion of stem, × 10; FIG. 3, lower surface of leaf, × 10; FIG. 4, rachis, bracts and calices, × 4

Photo. B. G. Schubert.

STACHYS AMBIGUA: FIG. 1, summit of plant, × ½; FIG. 2, portion of stem, × 10; FIG. 3, calices, × 4

ambigua. It was soon called *S. ambigua* (Gray) Britton (1894) but, on account of the earlier European *S. ambigua* Sm. (1810), the name was changed to *S. Grayana* House (1921). *S. aspera*, described from "*in campestribus* Carolinae", is a plant of sands and prairies from northern Florida to eastern Missouri, north to southern New Jersey, southeastern Pennsylvania, Kentucky, Illinois and Iowa; also adventive as a field-weed in Somerset County, Maine. It is, as Gray considered it, very close to *S. hyssopifolia* Michx., having the firm and scarcely veiny leaves almost of the latter but mostly broader, their lowest lateral nerves prolonged very close to the margin of the blade. From glabrous *S. hyssopifolia* it is distinguished only by the stems more or less retrorse-hispid on the angles, leaves sometimes broader and more regularly depressed-serrate, upper bracts often broadly-lanceolate to ovate (instead of linear or narrowly lanceolate), calyx often minutely pilose (instead of quite glabrous) and frequently setose on the angles. Gray's disposition of it, as *S. hyssopifolia*, var. *ambigua*, seems wholly justified. In the Carolinas and northeastward there are altogether too many transitions to support its separation as a species.

In his *Revision* Epling, l. c. 65, 66, including with the narrow-leaved *S. tenuifolia*, var. *hispida*, as above defined (PLATE 790), the generally more inland var. *platyphylla* (PLATE 789) as a species, *S. hispida*, was "inclined to believe *S. hispida* to have been derived from *S. ambigua*, probably after intermixture with *S. hyssopifolia*". He identified as *S. ambigua* Sm. Engl. Bot. xxx. pl. 2089 (1810) the very pilose and narrow-leaved extreme of *S. palustris* L. which I had described as *S. palustris*, var. *homotricha* Fernald in RHODORA, x. 85 (1918), which he also identified with the similarly long-pilose *S. velutina* Schwein. (1824), not Willd. (1813) and *S. arenicola* Britton (1901). Just why *S. ambigua* sensu Epling (PLATE 793) is identified with *S. ambigua* Sm., the European plant (PLATE 791), is not clear. He was advised of the error but did not wholly admit it, saying, p. 65, "Since the above was written I have had the privilege of discussing this form with Prof. G ö t e T u r e s s o n who is of the opinion that I have mis-interpreted the European hybrid *S. ambigua*. This, according to him is a rare and sterile plant. Until I can review the whole matter I am accordingly at as [a]

loss. Suffice it to say that the form here described as *S. ambigua* is scarcely to be distinguished from plants commonly referred to that species of European botanists".

Now, *Stachys palustris*, var. *homotricha* (PLATE 793), i. e. *S. ambigua* sensu Epling, is a stiff and normally simple-stemmed plant with the sides and angles of the stem and the rachis densely and retrorsely long-pilose or villous (FIGS. 2 and 3), the lanceolate to lance-linear leaves sessile and heavily pubescent beneath (FIG. 2), the calyx long-hirsute (FIGS. 2–5), the outside of the corolla strongly pilose. It occurs from Maine and southern Quebec to Wisconsin, south to Connecticut, southern New York, Ohio and Illinois (MAP 5). *S. ambigua* Sm., on the other hand, is a generally recognized sterile hybrid of typical European *S. palustris* (the latter only naturalized in Newfoundland, eastern Canada, New England and New York) and the endemic European *S. sylvatica* L., a plant with long-petioled cordate-ovate leaves. As shown by Smith's original plate and description and by many European specimens (our PLATE 791) it is a tall and loosely branched plant with the stem (FIG. 2) minutely strigose-pilose, the principal leaves definitely petioled, the divergent oblong-ovate blades minutely pilose beneath, the calyx short-pilose (FIG. 3) and the corolla only finely pilose. If it is inseparable from the indigenous North American *S. palustris*, var. *homotricha* (PLATE 793), it is time to give up.

As to Epling's belief that *Stachys hispida* in his sense, *i. e.* both *S. tenuifolia* var. *platyphylla* (PLATE 789 and MAP 3) and var. *hispida* (PLATE 790 and MAP 4), was derived from his "*S. ambigua*" (taking it for the American plant cited by him, our PLATE 793, and *S. hyssopifolia* Michx. (PLATE 788, FIGS. 3–5 and MAP 6) one may be pardoned a gasp of surprise. *S. palustris*, var. *homotricha* (*S. ambigua* sensu Epling) is shown in PLATE 793, *S. tenuifolia*, vars. *hispida* and *platyphylla* (*S. hispida*, inclusive, of Epling) in PLATES 790 and 789. Together the latter have a wide continental dispersal (MAPS 3 and 4), while *S. palustris*, var. *homotricha* is northern and within the northern range of the former. *S. hyssopifolia* (PLATE 788, FIGS. 3–5), is primarily a plant of the Atlantic Coastal Plain, but with the typical isolation at the head of Lake Michigan (MAP 6). It is strictly glabrous, with linear to narrowly oblong blunt to subacute, firm, pale,

entire leaves, so firm that, when fresh, only the midrib shows beneath, but, by transmitted light its leaves show the lower lateral veins following forward within 0.3–1 mm. from the margin, and its subglobose nutlets (FIG. 5) are only 1.5–1.8 mm. long. *S. hispida* and *S. ambigua* sensu Epling are both pubescent. Their leaves are from narrowly lanceolate to oblong-ovate and usually pubescent, veiny, with the lower pair of laterals following forward from 3–10 mm. within the copiously toothed margin, and their tips are acuminate; the nutlets (PLATE 792, FIG. 4) of *S. palustris* are ellipsoid-obovoid and 1.8–2.2 mm. long, those of *S. tenuifolia*, including *S. hispida*, similar and 2.1–2.7 mm. long (PLATE 788, FIG. 5). Just how, by crossing the narrow-, blunt- and firm-leaved, chiefly Coastal Plain *S. hyssopifolia* (PLATE 788, FIGS. 3–5) with the narrow-leaved continental and northern and by Epling misidentified *S. "ambigua"* (PLATE 793), with leaves 1–3 cm. wide, one gets the wide-ranging *S. hispida* sensu Epling (PLATES 789 and 790), with no trace of the pubescence of *S. "ambigua"* on stem, leaves and calyx and with leaves up to 6 cm. broad, is beyond my understanding. Is this modern phylogeny?

OUR VARIETIES OF STACHYS PALUSTRIS (PLATE 792–794)—During this study of *Stachys* it has been necessary to unravel our variations of *S. palustris*. This is a northern, circumboreal species with two pronounced subspecies, each with several geographic varieties. Typical Eurasian *S. palustris* L. has the calyx (PLATE 792, FIG. 3) closely viscid-pilose with many gland-tipped hairs mixed with short glandless ones, the latter rarely more than 1 mm. long. It and three of the varieties recognized in Europe are naturalized about towns and settlements, often about ports, in various parts of Newfoundland, Quebec, eastern Ontario, the Maritime Provinces, New England and New York. The native North American plants differ in having the calyx long-hirsute as well as short-pilose, the shorter pubescence largely hidden by long whitish and glandless setiform trichomes mostly 1.5–3 mm. long. This is subsp. *pilosa* (Nutt.) Epling, based on *S. pilosa* Nutt. in Journ. Acad. Phil. vii. 48 (1834). The native subsp. *pilosa* consists, in the Gray's Manual range, of five rather well defined varieties. These I am distinguishing as follows.

a. Leaves sessile or on very short and inconspicuous thick petioles....*b.*

b. Principal leaves oblong to oblong-ovate or oval, blunt or merely subacute, three tenths to one half as broad as long, 3.5–12 cm. long, 1.5–5 cm. broad; chiefly western...Var. *pilosa.*

b. Principal leaves narrowly to broadly lanceolate or narrowly oblong, acuminate, one seventh to one third as broad as long, 2–13 cm. long, 0.4–3 cm. broad; chiefly eastern and northern....*c.*

c. Pubescence of sides of stem many times shorter than that of angles, or minute and with long hairs of angles wanting.

Angles of stem retrorsely long-hirsute, sides short-pilose; leaves lanceolate to oblong, the principal ones 4–13 cm. long and 0.8–3 cm. broad, strongly hispid on the veins and pilose on the surfaces beneath; boreal and transcontinental.....Var. *nipigonensis.*

Angles of stem with few or no long hairs, sides minutely and retrorsely appressed-pilose-puberulent; leaves narrowly lanceolate, the principal ones 2–5.5 cm. long and 0.4–1.5 cm. broad, sparsely and minutely puberulent to glabrous beneath; plant of Upper Great Lakes region.....Var. *macrocalyx.*

c. Pubescence of sides of stem very dense and long, as long as and not readily distinguished from that of the angles.....Var. *homotricha.*

a. Leaves slender-petioled, the petioles of the principal ones 1–1.4 cm. long, the oblong or lance-ovate acuminate blades mostly 6–12 cm. long and 2–4 cm. broad; angles of stem with relatively few or no long hairs.....Var. *phaneropoda.*

S. PALUSTRIS L., var. **pilosa** (Nutt.), stat. nov. *S. pilosa* Nutt. in Journ. Acad. Phil. vii. 48 (1834). Subsp. *pilosa* (Nutt.) Epling in Fedde, Repert. Beih. lxxx. 63 (1934). *S. scopulorum* Greene, Pittonia, iii. 342 (1901).—Shores, stream-margins, meadows, etc., British Colombia to Arizona, east to Ontario, Wisconsin, Illinois, Nebraska, and adventive along railroads and in waste places eastward to New England (several collections from near stations along the Canadian Pacific and Grand Trunk Railroads).

Var. NIPIGONENSIS Jennings in Journ. Wash. Acad. Sci. x. 459 (1920).—Low grounds, Quebec to Alaska, south to western New England, New York, Ohio, Michigan, Illinois, Iowa, New Mexico and Arizona.

Var. MACROCALYX Jennings, l. c. 458 (1920).—Shores, Thunder Bay District, Ontario, to northern Wisconsin and northern Minnesota.

Var. HOMOTRICHA Fernald in RHODORA, x. 85 (1908). *S. velutina* Schweinitz in Long's Exped. Winnip. ii. 390 (1824), not Willd. (1813). *S. arenicola* Britt. Man. 792 (1901). *S. palustris*, var. *arenicola* (Britt.) Farw. in Am. Midl. Nat. xl. 82 (1928). *S. Schweinitzii* Rydb. in Brittonia, i. 95 (1931). *S. homotricha* (Fern.) Rydb. l. c. (1931). *S. pustulosa* Rydb. l. c. (1931).—

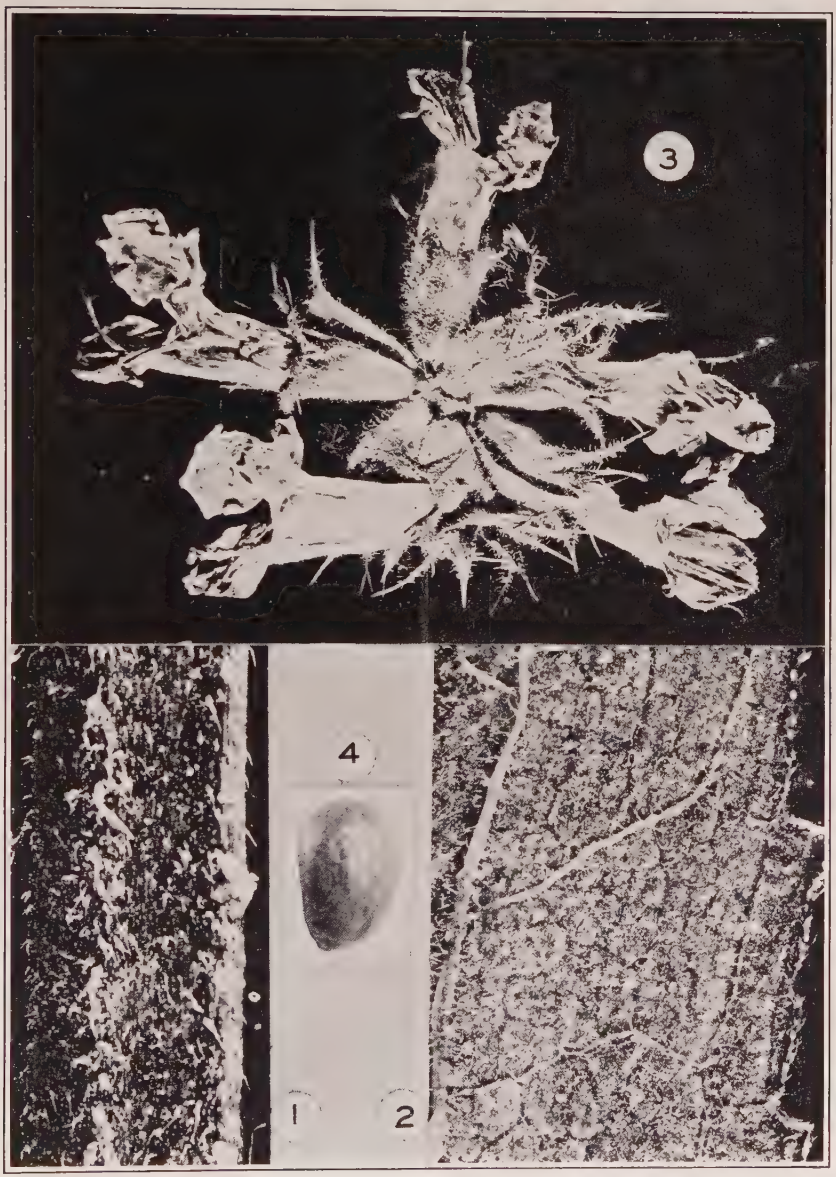


Photo. B. G. Schubert.

STACHYS PALUSTRIS: FIG. 1, portion of stem, × 10; FIG. 2, lower leaf-surface, × 10; FIG. 3. bracts and flowers, × 4; FIG. 4. nutlet, × 10

Photo. B. G. Schubert.

STACHYS PALUSTRIS, var. HOMOTRICHA: FIG. 1, one of TYPE-specimens, × ⅜; FIG. 2, lower bracts and calyx, × 4, from TYPE; FIG. 3, stem and lower surface of leaf-base, × 10, from TYPE; FIG. 4, narrow-leaved plant (*S. arenicola* Britt.), × ½; FIG. 5, calyx of the last, × 10

Shores, meadows and fields, Maine and southern Quebec to Wisconsin, south to Connecticut, New York, Ohio and Illinois. PLATE 793, MAP 5.

Var. **phaneropoda,** var. nov., Weatherby in herb. (TAB. 794) foliis petiolatis, petiolis (foliorum principalium) 1–1.4 cm. longis, laminis oblongis vel lanceolato-ovatis 6–12 cm. longis, 2–4 cm. latis; setis in angulis caulis ex comparatione paucis vel carentibus. OHIO: Port Clinton, Ottawa County, July 31, 1894, *Moseley.* WISCONSIN: Spooner, July 20, 1911, *J. J. Davis.* IOWA: riverbank, Estherville, July 31, 1925, *B. O. Wolden,* no. 1118, TYPE, in Herb. Gray.

PLATE 787. STACHYS TENUIFOLIA Willd.: FIG. 1, plant, × ½, from Cypress Bridge, Nottoway River, Southampton County, Virginia, *Fernald & Long,* no. 6370; FIG. 2, surface of stem, showing lack of pilosity, × 10, FIG. 3, lower surface of leaf, × 10, and FIG. 4, bracts and flower, × 4, all from James River at Harrison Point, Charles City County, Virginia, *Fernald & Long,* no. 9133.

PLATE 788, FIGS. 1 and 2, S. TENUIFOLIA, var. PERLONGA Fernald: FIG. 1, ISOTYPE, × ⅔; FIG. 2, bracts and calices, × 4. FIGS. 3–5, S. HYSSOPIFOLIA Michx.: FIG. 3, plant, × ½, from southeast of Yorktown, Virginia, *Fernald & Long,* no. 8835; FIG. 4, bract and mature calyx, × 4, from south of Yorktown, *Fernald, Long & Fogg,* no. 5016; FIG. 5, nutlet, × 10, from Sandwich, Massachusetts, October 23, 1922, *Fernald.*

PLATE 789. S. TENUIFOLIA, var. PLATYPHYLLA Fernald: FIG. 1, TYPE, × ⅔; FIG. 2, surface of stem, the pustular-based hairs of the angles bent by pressing, × 10, from Alburg, Vermont, July 16, 1939, *C. H. Knowlton;* FIG. 3, lower surface of leaf, × 10, and FIG. 4, rachis, bracts and calices, × 4, from same place as FIG. 2; FIG. 5, nutlet, × 10, from Chaumont, New York, *Fernald, Wiegand & Eames,* no. 14,429.

PLATE 790. S. TENUIFOLIA, var. HISPIDA (Pursh) Fernald: FIG. 1, plant, × ½, from Rosemont, Princess Anne County, Virginia, *Fernald & Long,* no. 5017; FIG. 2, portion of stem, with nearly glabrous sides but strongly hirsute angles, × 10, FIG. 3, lower surface of leaf, × 10, and FIG. 4, rachis, bracts and calices, × 4, from Sharon, Massachusetts, July 12, 1896, such plants from Sharon specially noted in Gray Herb., by Epling, as like Pursh's type.

PLATE 791. S. AMBIGUA Sm.: FIG. 1, summit of plant, × ½, from Borgholm, Öland, Sweden, July 20, 1886, *Areskug;* FIG. 2, portion of stem, × 10, from same plant; FIG. 3, calices, × 4, from Austria, *Bot. Tauschver. Wien.*

PLATE 792. S. PALUSTRIS L.: FIG. 1, portion of stem, × 10, from Bouillon, Belgium, August 10, 1933, ex *Herb. Hort. Brux.;* FIG. 2, lower surface of leaf, × 10, and FIG. 3, two whorls of flowers, × 4, from same collection; FIG. 4, nutlet, × 10, from ballast-filling, York, Gaspé County, Quebec, *Collins, Fernald & Pease* (*Pease,* no. 5062½).

PLATE 793. S. PALUSTRIS, var. HOMOTRICHA Fernald (*S. ambigua* sensu Epling, not Sm.): FIG. 1, plant of TYPE, × ⅜; FIG. 2, lower bracts and calyx, × 4, from TYPE; FIG. 3, stem and lower surface of leaf-base, × 10, from TYPE; FIG. 4, narrow-leaved extreme (*S. arenicola* Britton), × ½, from Copper Harbor, Michigan, *Farwell,* no. 281); FIG. 5, two calices, × 4, from no. 281.

PLATE 794. S. PALUSTRIS, var. PHANEROPODA Weatherby: FIG. 1, TYPE, × ½; FIG. 2, stem, × 4; FIG. 3, calyx, × 10.

PYCNANTHEMUM VERTICILLATUM (Michx.) Pers. A second Coastal Plain station, this in NORFOLK COUNTY: damp old clearings and thickets, eastern side of Great Dismal Swamp, north of Wallaceton, nos. 13,736 and 14,007.

P. PYCNANTHEMOIDES (Leavenw.) Fern., var. VIRIDIFOLIUM Fern. A second Coastal Plain station, this in SOUTHAMPTON COUNTY: border of dry woods northeast of Adams Grove, no. 14,398.

VERBENA OFFICINALIS L. To the relatively few stations add one in SOUTHAMPTON COUNTY: roadside bordering Womble's (Wade's) Millpond, north of Baffle, no. 14,395.

PHYSALIS MONTICOLA C. Mohr. Range extended northeastward to ISLE OF WIGHT COUNTY: sandy wooded slope by Blackwater River, west of Blackwater School, no. 14,400, unusually large, up to 3.5 dm. high. See p. 370.

*LINARIA CANADENSIS (L.) Dumort., forma **albina,** f. nov., corollis albidis.—VIRGINIA: burned spot, white sand of dry pine barrens, south of Lee's Mill, Isle of Wight County, April 21, 1942, *Fernald, Long & Abbe,* no. 14,230 (TYPE in Herb. Gray.).

GRATIOLA VIRGINIANA L., var. AESTUARIORUM Pennell. Range extended inland to BRUNSWICK COUNTY: open mud by Triplett Pond, Seward Forest, near Triplett, *Fernald & Lewis,* no. 14,497. See p. 380.

UTRICULARIA PURPUREA Walt. Local range extended inland to SUSSEX COUNTY: Harold's (or Harris) Millpond, southeast of Waverly, no. 14,408. See p. 371.

U. INFLATA Walt. Local range extended inland to SUSSEX COUNTY: back-water pool by Nottoway River at Readjuster Bridge, south of Peanut, *Fernald, Long & Abbe,* no. 14,231.

U. INFLATA, var. MINOR Chapm. To the very few recorded stations add the following. SOUTHAMPTON COUNTY: quiet pool in cypress swamp bordering Womble's (Wade's) Millpond, north of Baffle, no. 14,406. SUSSEX COUNTY: Harold's (or Harris) Millpond, southeast of Waverly, no. 14,407. See pp. 371 and 372.

U. VIRGATULA Barnhart. To the few recorded stations add one in SOUTHAMPTON COUNTY: on a decaying log in mossy margin of *Cephalanthus*-pool near Johnson's Millpond, north of Sedley, no. 14,411. See p. 371.

OLDENLANDIA BOSCII (DC.) Chapm. To the only two recorded Virginia stations, in southern Southampton County, add the following. SUSSEX COUNTY: sandy-muddy shore, Brittle's Millpond, west of Wakefield, no. 14,417; sandy beach, Airfield Millpond, southwest of Wakefield, no. 14,419. SOUTHAMPTON COUNTY: sandy shore of Johnson's Millpond, 1½ miles north of Sedley, no. 14,416. ISLE OF WIGHT COUNTY: muddy and swaley shore of Darden's Pond, southeast of Collosse, no. 14,418. See pp. 371 and 372.

*LOBELIA SIPHILITICA L., forma **laevicalyx,** f. nov., foliis glabris; caulibus vix pubescentibus; calycibus corollisque glabris.—Isle of Wight County, VIRGINIA: seeping argillaceous and calcareous bluffs along Burwell's Bay, James River, below Rush-

Photo. B. G. Schubert.

STACHYS PALUSTRIS, var. PHANEROPODA, all figs. from TYPE: FIG. 1, plant × ½; FIG. 2, surface of stem, × 4; FIG. 3, calyx, × 10

Photo. B. G. Schubert.

GNAPHALIUM PEREGRINUM, TYPE, × $\frac{2}{5}$

mere (Fergusson's Wharf), August 27 and 29, 1940, *Fernald & Long*, no. 12,834, October 10, 1941, *Fernald & Long*, no. 14,030 (TYPE in Herb. Gray; ISOTYPE in Herb. Phil. Acad.).

My attention was directed to this extremely smooth form by Dr. Wray M. Bowden of the Central Experimental Farm at Ottawa, Ontario. I had supplied Dr. Bowden with seeds from no. 14,030 and from some other species in the autumn of 1941. On October 14, 1942, I received from him a letter from which the following passages are extracted:

"Just a note to ask if you could examine your specimen of *Lobelia siphilitica* L., *Fernald and Long*, no. 14,030 . . . You sent seed from this last year and the plants have grown well. The row was quite uniform but not at all like any of the numerous collections of *L. siphilitica* which I have. The stems and leaves are glabrous. The upper leafy bracts in the flower-spike are much longer and pointed, and the calyx is not nearly as pubescent—in fact only the free ends of the lobes are pubescent. The row was quite uniform both in respect to these characters and to colour of corolla which was light blue. . . The corolla is quite glabrous also."

The original specimens have the leaves, calyx and corolla quite glabrous, but the stem is remotely hispid. Other collections from calcareous bluffs of the James are more pubescent. The plant below Rushmere seems to me best treated as a forma, typical *L. siphilitica* having the stem and one or both faces of the leaves variously pubescent, the calyx always more or less so and the tips of the corolla-lobes bearded. Among these more typical plants I find some with quite as prolonged bract-tips as in the Rushmere plant.

L. GLANDULIFERA (Gray) Small. Local range extended into Brunswick County: sphagnous thicket, "Ram Hole Swamp", Seward Forest, near Triplett, *Fernald & Lewis*, no. 14,500. See p. 377.

*EUPATORIUM ROTUNDIFOLIUM L., var. **cordigerum,** var. nov., planta robusta ad 1.3 m. alta caule densissime albido-pilosotomentuloso; foliis mediis late ovatis subacutis sessilibus valde cordatis 5–8.5 cm. longis 4–7 cm. latis subaequaliter dentatis subtus dense pilosis.—VIRGINIA: upper border of fresh reed-marsh and swale along Northwest River near Northwest, Norfolk County, June 30, 1942, *Fernald & Long*, no. 14,426 (TYPE in Herb. Gray.; ISOTYPE in Herb. Phil. Acad.); mossy thicket by *Cephalanthus*-pool near Johnson's Millpond, north of Sedley, Southampton County, July 4, 1942, *Fernald & Long*, no. 14,427, October 14, 1942, *Fernald*, no. 14,502. NORTH CAROLINA: roadside near Windsor, Bertie County, October 15, 1938, *Godfrey*, no. 7007. See pp. 369 and 371.

Var. *cordigerum* is a very extreme variation in the polymorphic *Eupatorium rotundifolium*. In size of plant and of foliage it suggests the wide-ranging var. *ovatum* (Bigel.) Torr. (*E. pubescens* Muhl.) but its dense pubescence is more like that of typical small-leaved *E. rotundifolium*. In its strongly cordate, instead of gradually rounded, leaf-bases it is very striking, the cordate bases of the middle and upper leaves reaching nearly around the stem.

Liatris graminifolia Willd., var. Smallii (Britt.) Fern. & Grisc. Local range extended into Sussex County: damp sandy pine and oak woods south of Stony Creek, no. 11,455.

Boltonia caroliniana (Walt.) Fern. Range extended inland to Brunswick County: bottomland woods above Western Bridge, Meherrin River, south of Edgerton, *Fernald & Lewis*, no. 14,512, rays pink. See p. 379.

*Erigeron strigosus Muhl., forma discoideus (Robbins) Fern. Nansemond County: open ground along highway, northern border of Great Dismal Swamp, east of Magnolia, no. 14,436.

*Solidago salicina Ell. Brunswick County: open bog near Seward Forest Headquarters, September 14, 1940, *J. B. Lewis;* boggy thicket, "Ramhole" Swamp, Seward Forest, Triplett, *Fernald & Lewis*, no. 14,506.—Extension northward from Wake County, North Carolina; most specimens (from North and South Carolina and west to Texas) previously confused with the northern and upland calcicolous *S. patula*. See p. 377.

S. salicina is a very definite southern species of acid bogs of the inner Coastal Plain and outer Piedmont, at once distinguished from *S. patula* by its narrower and more crenate leaves, the cauline ones 20–45 (in *S. patula* 12–23) and rapidly reduced in size, the more open panicle with more elongate and glabrescent branches floriferous at tip, the long-pedicelled heads borne strictly along the upper sides of the branches (in *S. patula* the shorter-pedicelled heads tending to be in short racemes subspirally borne along the white-pilose panicle-branches).

Gnaphalium spathulatum a later Homonym (Plate 795, the type, × 2/5).—It seems to have been overlooked that *Gnaphalium spathulatum* Lam. Encycl. ii. 758 (1786) is antedated by *G. spatulatum* Burm. f. Fl. Cap. Prodr. 25 (1768) which was the binomial based directly on the well described *Elychrysum foliis oblongis circa caulem auritis & tomentosis* of Breyn, Prodr. 29, t.

xviii. fig. 3 (1739), this being referred by Index Kewensis to *Helichrysum crispum* D. Don, not *H. spatulatum* Moench. The plant which generally passes as *Gnaphalium spathulatum* cannot, therefore, maintain that name. The exact identity of Lamarck's type is yet to be worked out. The habit-photograph of it before me is good as such, but until the technical characters can be closely studied it would be unsafe to base a new name upon it. The group of annuals and biennials to which it belongs is most complex, a series of ruderal and campestrian plants of tropical and warm-temperate regions of which the characters reside in habit, shape and indument of leaves, indument of stem, indument of involucre, shape of phyllaries, etc. The plant usually passing as *G. spathulatum* is wide-spread in South America, and in North America from Florida to Texas, north to southeastern Pennsylvania and southern California. Superficially it strongly resembles *G. platense* Cabrera, Compuestas Bonaerenses, 167, fig. 45 (1941), but that species, as clearly illustrated by Cabrera, has the leaves and stems copiously glandular, the elongate pluricellular glands of the stem divergent, and the inner phyllaries slender-tipped. Cabrera refers *G. spathulatum* Lam. to *G. americanum* Willd., but certainly the plant of our southern states is not the West Indian *G. americanum*, which is very near *G. purpureum* L. Until the whole complex group can be most thoroughly studied, with intimate knowledge of the actual types and their technical characters, it would be quite unwise to rename the poorly understood *G. spathulatum* Lam. (originally a garden-plant). I am, therefore, at the risk of publishing a name which eventually may have to be discarded, proposing a new name based upon an unequivocal type.

Gnaphalium (§ Gamochaeta) **peregrinum,** sp. nov. (tab. 795), bienne vel annuum; caulibus subsimplicibus vel plerumque ramosis 1–6 dm. altis griseo-lanatis; foliis caulinis anguste spathulato-obovatis vel late oblanceolatis apice rotundatis, imis 2–7 cm. longis 0.8–2.5 cm. latis, subtus villoso-lanatis supra deinde viridescentibus; capitulis stramineis glomerulatis glomerulis subdistantibus spicam interruptam 1–2 cm. crassam formantibus; involucris 3–4 mm. altis basi valde lanatis; phyllariis interioribus oblongis vel spathulatis obtusis.—Roadsides, fallow fields and waste places, Florida to Texas and southern California, north, locally, to southeastern Pennsylvania; eastern South

America. TYPE: in burnt-over pine-scrub oak sandhills, north edge of Pineville, Rapides Parish, Louisiana, July 30, 1938, *D. S. & H. B. Correll*, no. 9937 (in Herb. Gray.).

G. OBTUSIFOLIUM L., var. HELLERI (Britt.) Blake. To the stations much farther east add one in BRUNSWICK COUNTY: sandy pine woods, Seward Forest, near Triplett, *Fernald & Lewis*, no. 14,514. See p. 380.

G. OBTUSIFOLIUM, var. MICRADENIUM Weath. Range extended inland to BRUNSWICK COUNTY: dry woods near Rattlesnake Creek, west of Triplett, *Fernald & Lewis*, no. 14,513. See p. 380.

(*To be continued*)

VICIA TETRASPERMA, VAR. TENUISSIMA IN AMERICA.—The common little weed, *Vicia tetrasperma* (L.) Moench, has oblong, round-tipped and merely mucronulate leaflets. The slender-leaved var. *tenuissima* Druce is beginning to appear with us. Its narrowly linear leaflets are attenuate to slender tips. I have examined specimens from Maine, Vermont, Massachusetts, New York and Oregon, all collected within the last half-century.—M. L. FERNALD.

Volume 45, no. 538, including pages 357–416 and plates 770–782, was issued 9 October, 1943.

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